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PROCEEDINGS

OF THE

ROYAL PHILOSOPHICAL SOCIETY

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Kings had themselves not only the wider outlook which travel brings, but in addition they possessed in their own persons that admixture of blood which they wished to infuse into their people.

Many of our historians attribute this policy during the reign of Malcolm Ceanmore entirely to the influence exercised by his wife. Queen Margaret is represented as "wedded to a rude husband—no unmeet type of his barbarian realm"—and she is said to have "subdued his wild nature until he became the gentle minister of her wishes, the partner of her never-ending works of charity and mercy—eager to share in her long vigils and frequent prayers—gazing fondly on her books which he could not read, or carrying them away by stealth that he might bring them back to their mistress with new and costly adornments."[1] The "Life of Queen Margaret," doubtfully attributed to Turgot, which is a panegyric, and not to be taken too literally as John of Fordun has done,[2] has helped to accentuate this view. But it puts out of court the King's own judgment, and makes him a puppet, and a dull one, in the hands of his wife. The facts point in another direction. Malcolm, as is well known, entered into a treaty with William the Conqueror at Abernethy in 1072. Now from the Northamptonshire Geld Roll we find that not later than 1075 the King of Scots held land "in Northampton, a shire," as Mr. Round says, "where his successors were to hold it so largely."[3] Thus he was in his own person as a feudal vassal of the King of England brought into contact with Norman feudal institutions, and into a position to judge, from what he saw, of their value to the Crown as a source of strength both in peace and war. His judgment was favourable as the policy he adopted shows. The King deserves credit for taking the step which initiated the active pursuit of the policy in question, by welcoming the Princess Margaret with her mother, and her brother and sister, to his court, and by proposing for her hand. It is the first step which counts, and this was taken by the King. His was a fierce and relentless nature, with all the fire and fury of his race, when he donned his armour and led his heterogeneous followers into the field of battle. This however was not incompatible, in that age, with deep devotion to religion, and a determination to promote, as making for the stability of his throne, and the progress of his people, the introduction of new settlers from the south in large numbers, bringing with them not only their laws and customs, but also their form of Christian worship.

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[1] Robertson, *Scottish Cathedrals and Abbeys, Quarterly Review,* Vol. xxxv. p. 115.

[2] Fordun, *Chronicle* (Skene's Edition), Book v. c. 18.

[3] Round, *Feudal England,* p. 148.

It was afterwards felt that early biographers had attributed a dangerous independence of character to Queen Margaret,—that as a saint she was in a fair way of setting a bad precedent of petticoat government in high places. This tendency must be counteracted at all hazards, and thus we find in the Breviary of Aberdeen a detailed account of the difficulties which attended the translation of St. Margaret.[1] As Andrew of Wyntoun carefully chronicles the circumstances in the vernacular, we may recall his words. He tells that when, by the third Alexander,

. . . "wyth weneratyoun,
"Wes made the translatyoun
"Off Saynt Margret, the haly Queene,"

it was found impossible at first to move her body a single inch from the spot where it lay. All the power of the Papal Bull availed nought, although reinforced by the active assistance of

"Erlys, byschapys, and barownys,
And many famows, gret persownys,"

until

". fyrst thai tuk wpe the body
"Of hyr lord, that lay thare-by,
"And bare it ben in to the qwere.
"Lychtly syne on fayre manere
"Her cors thai tuk up, and bare ben,
"And thame enteryd togyddyr then.
"Swa trowyd thai all that gadryd thare,
"Quhat honoure till hyr lord scho bare."

That there may be no mistake whatever on the subject, the Prior of St. Serf's repeats the moral to be drawn from the miracle:

"Swa this myrakill to record,
"Notis gret reverens dwne till hyr lord,
"As scho oysyd in hyr lyff,
"Quhen scho wes hys spowsed wyff."[2]

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[1] Mox ferencium brachia reddebantur in tantum fatigata et lassa pre nimia ponderis gravitate quod feretrum ipsum cum reliquiis de loco amoveri non poterant. *Breviarium Aberdonense*, Vol. I., fol. 1°.

[2] Wyntoun, *Chronicle* (Laing) Vol. II., pp. 250-1.

After all this, I think you will agree that it is not only doubtful history but rank heresy to represent Queen Margaret as striking out a line entirely for herself in Church and State.

During Malcolm's exile in England, which lasted for fifteen years,[1] after the death of his father, King Duncan, during the reign of Macbeth, he had ample opportunity of becoming "the first illustrious specimen of that much vilified person, the Anglicised Scot." This, with his personal knowledge of the working of the feudal system, is sufficient to account for his favour towards picked emigrants from England. He was far from being an uneducated Celt. If we may take Fordun's testimony, he had mastered three languages,[2] English, French, and his native tongue; and it would have been strange had it been otherwise, after his lengthened sojourn in England. These migrations of English settlers into the Lowlands of Scotland have been characterised by a recent historian as the beginning of that "long process by which English brewers, soap-boilers and upholsterers sit in the seats of Macdonnels and Macphersons."[3] One may observe in passing that there is a reverse to the shield, and that in more recent years Macdonnels and Macphersons and Campbells, as well as Lowland Scots, have gone South, with profit to themselves and advantage to the land of their adoption.

What effect had this policy upon the Scottish Church? Its result, as is well known, was a revolution in Church government in Scotland. It is true that it was gradual and bloodless. It, nevertheless, had its martyrs, although they were probably not of the heroic type, and have left scanty records of their opposition to being superseded by churchmen from the south. It is outside the scope of our present enquiry to go into the history of the Clan Monasteries which the early Irish missionaries appear to have planted in the country,—from Melrose in the south to Monymusk and Deer in the north.[4] The fact of the Scottic Church being a monastic one made it probably easier to introduce the various monastic orders of the Roman Church into Scotland. The laity were accustomed to the form of religious life lived in Christian colonies, and, if one may generalise where the evidence is mainly negative, looked with favour on the reforming movement, or at least were not opposed to measures which promised to impart new vigour to monastic institutions. Still, there exists proof that the communities of Keledei, who represented the Tribal Church, offered resistance in places to being superseded by the Diocesan Church, and showed here and there throughout the country some sparks of vitality ere they finally expired. One of the earliest steps in the reforming movement was taken when Lanfranc, Archbishop of Canterbury, in compliance with Queen Margaret's request sent her Goldwin and two other brethren to help her husband and her in the work of Church reform. It is likely that these brethren were English Benedictines. In the Archbishop's letter he pays a tribute to her husband, calling him "vir gloriosus tuus,"—no mere empty compliment, but rather a distinct acknowledgment of Malcolm's zeal in promoting the good cause. A further step was taken when Robert, an Englishman, along with five others, was brought from St. Oswald's, in Yorkshire, to establish the Augustinian rule at Scone. The Abbot of Scone became Bishop of St. Andrews, in succession to Turgot, where he founded, under the auspices of King David, a Priory of Regular Canons, to which the hospital of the Keledei was eventually transferred.[1] The Keledei, like all threatened institutions with a history in this country, lived long, and, although in the reign of Malcolm's youngest son David, active measures for their suppression were taken, yet nearly a hundred years after the death of the latter, we find them still in existence in various places. Thus at St. Andrews, Dunkeld, Brechin, Dunblane, Iona, Rosemarky in Ross-shire, Dornoch in Sutherlandshire, and in other localities, traces of them are to be found as late as the middle of the thirteenth century. The places where they linger on are mostly those where they formed the Cathedral Chapter and had rights of old-standing in the election of the Bishop when a vacancy occurred. In Brechin, for example, there was evidently difficulty in the year 1250—not, however, caused by the See being vacant. A Bull by Pope Innocent IV. to the Benedictine Abbey of Lindores, confirming its right to the Parish Church of Dundee, expressly provides that the grant formerly made by the Bishop of Brechin, with consent of his Chapter, shall not suffer prejudice "from the fact that the brethren who have been accustomed to be in the

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[1] Fordun *Chronicle*, Book V., c. 14.

[2] "Plene didicerat" are Fordun's words.

[3] Lang, *History of Scotland*, Vol. I., p. 99.

[4] Reeves *On the Culdees*, p. 151.

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[1] Reeves, *On the Culdees,* p. 223. The Priory was founded in 1144.

Church of Brechin were called Keledei, and now by change of name are styled Canons." There was evidently a fear on the part of the monks that their title to the Church of Dundee was liable to challenge. What we do in the twentieth century by Act of Parliament and Executive Commission, we did in the thirteenth by Papal Bull. This, and other Papal Bulls, let us see the method adopted to bring the Kaledei into line with Roman institutions. They were gradually transformed into a body of Regular Canons as being the nearest order to their own. The Church disclosed a toleration and wisdom in dealing with them which have been often sadly wanting in later times. Thus they were gradually absorbed into the Western Church..

All intelligent persons, every one possessing an eye to appreciate the beauty, and a soul to be impressed by the solemn dignity clinging like the ivy to many a crumbling arch or ruined aisle, must be filled with admiration on viewing the remains of our ancient architecture. This seems an absolute truism, and yet even among those who occupy positions of influence in our midst neglect and indifference are rampant to this day with dire results. As a recent writer remarks " Educated people know little and care less about architecture. Classic and Renaissance, Romanesque and Gothic, are naught to them; their ignorance is naked and unashamed."[1]

Instances of this Philistine attitude even at our own doors are still unfortunately too common, and yet one would imagine that the possession or control of some venerable relic of the past which has "stood against the waves and weathers of time," would arouse the dormant feeling of respect for the memorials and records of early ages which surely must exist somewhere in every nature having any claim to be called civilized. Dr Johnson, who was not easily moved to approval of anything Scotch, declared that he should scarcely have regretted his journey to Scotland had it afforded nothing more than the sight of the Abbey of Aberbrothick. An age which gave us so many noble buildings, showing even in decay evidences of former grandeur and beauty, could not be an altogether barbarous period of the world's history. In ecclesiastical architecture we are, at the present day, even at our best, merely adaptors and copyists of the masterpieces which the eleventh, twelfth, and thirteenth centuries have bequeathed to us.

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[1] Bond, *Gothic Architecture in England*, p. xvii. Writing in 1887, the authors of "The Castellated and Domestic Architecture of Scotland" say regarding one of our finest old baronial houses—" Aberdour Castle is a charming specimen of an old Scottish residence with quaint crow-stepped gables and corner sun-dial overlooking its fine terraced walks. Such a house, without sacrificing any of its characteristic features, might be inhabited to this day. But instead of being kept in the order which such a fine example deserves, the most complete and heartless neglect reigns over the whole place. The greater portion of the buildings, including those erected by the great Regent, are used as cow-byres and piggeries, while the church, one of the most complete Norman structures in Scotland, is in a similar state of heedless neglect."

Those who have seen the magnificent modern Cathedral which has been built from plans by the late Mr. Pearson at Truro in Cornwall must have been struck by its faithful adherence to mediæval models. In fact, with all our modern enlightenment and advance in science, we cannot get beyond the designers and craftsmen of seven hundred years ago in this branch of art. A thought such as this is calculated to make us pause, and to cause us to ask ourselves one or two unpleasant questions—such as, Is our present-day civilization all advance? Have we not rather gone back in some things? Have we not ceased to get those glimpses which a less artificial age gained through—

> ". . . magic casements, opening on the foam
> Of perilous seas, in faëry lands forlorn?"

In Scotland, as elsewhere, it will be found that many of the most picturesque and beautiful remains of early church architecture which are scattered over the land are ruins of religious houses—Abbeys, Priories, Preceptories, and Friaries.

Who were the men by whom, and for whom, these buildings were erected, and whence did they come? And at what period, if strangers, did they enter Scotland?

From what we now know regarding the migrations from the south, we are prepared to learn that the Scottish ecclesiastics of the higher ranks were almost in every case from the time of Malcolm Ceanmore, on to the end of the reign of his youngest son, men of Saxon and Norman blood. The age, led by the Royal House and the nobles, was very modern in its ideas, and the latest forms of Church government and worship were imported into Scotland, with, so far as can be seen, wonderfully little opposition, and that little confined to the north of the Forth.

The earliest list of the Religious Houses in Scotland is a catalogue at the end of the "Chronicle of Henry of Silgrave," about A.D. 1272.[1] It is evidently only a jotting of those houses of the different Orders which occurred to the writer. It does not profess to be, and is not in fact, by any means complete. Those monasteries are given which appeared important enough to be noted, or were otherwise known to the scribe, and he clearly intended to add the dedications, but apparently he was in doubt about many of them at the time of writing, and, except in a few instances, they have not been inserted. Forty different Religious Houses in our country are mentioned, but the list contains several errors in regard to the Order of Monks occupying these. "It seems," says Dr. Reeves, "to refer to a state of things anterior to its own date." It treats of Lothian under a separate heading from Scotland. Thirteen different Religious Houses, five of them Nunneries, are enumerated as being within its bounds. No less than six of these thirteen owe their foundation to David I.

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[1] It is printed in Haddan & Stubbs' *Councils and Ecclesiastical Documents*, vol. II., p. 181.

The value of this jotting has been exaggerated. It is clearly untrustworthy, as it contains many errors, and unless supported by other authorities is not a safe foundation on which to build any important theories regarding the early Church in our land. When the writer deals with Scotland he mentions twenty-seven foundations, of which only four, if we exclude Bishoprics, owe their introduction to King David. In eight of these twenty-seven "Keledei" are still found. But with one exception,—that of Hy or Iona,—these are all Bishoprics.

Bishop Reeves used Silgrave's Catalogue as one of the groundworks of his learned essay *On the Culdees*, but his conclusions are all strengthened by a careful survey of other contemporary authorities.

A later list of Religious Orders and their Houses in Scotland was compiled towards the close of the fifteenth century. It is to be found in the Marchmont Manuscript of the *Book of Pluscarden*, and has been printed in the appendix to Mr. Skene's edition; and it also appears in the *Black Book of Paisley* and other manuscripts of the *Scotichronicon*. This catalogue contains ninety-four foundations, and the compiler, in the case of the Abbeys, Priories, and Nunneries, has endeavoured not only to mention the Order to which each House belonged, but also to state the name of the pious Founder. Its date can be fixed approximately from internal evidence as after 1445 and before 1500. Although much more complete than the earlier catalogue, it is not free from omissions. It is, however, valuable as being early, and because it contains some information regarding the nunneries in mediæval Scotland, a subject on which we have little exact knowledge. The writer enumerates ten Houses of Nuns, and states that all of these except Iona belonged to the Cistercian Order. He omits all reference to the Franciscan Nuns or Claresses, introduced into Scotland during the reign of James I. of which Order we had a Nunnery at Aberdour in Fife, and also in Dundee.

Reverting to Silgrave's Catalogue,—the earlier of the two,—we may take a few of the entries with which it opens as serving to introduce us to several of the most important Orders of Religious in our land in early times. What Orders are mentioned first of all? We find Monachi Albi, White Monks, in the first two monasteries, Newbotle and Melrose. That is Cistercian. They were a very popular Order here as elsewhere, and it is interesting to note, as showing that no deep-seated jealousy between the two nations, Scotland and England, existed originally, that although founded by St. Robert of Molesme in A.D. 1098, as an offshoot of the Benedictines, it was an Englishman—St. Stephen Harding—who really gave a definite constitution to the Order. To name the Cistercian Monasteries in Scotland is to give a list containing some of the most influential religious foundations in our country during the middle ages, the ruins of which are still among the most picturesque remains of ecclesiastical architecture we have. There were twelve Cistercian Convents, all founded before the death of Alexander III., and all Abbeys except one. Their names are Melrose, Newbotle near Edinburgh,[1] Dundrennan, Kynloss in Moray, Coupar in Angus, Glenluce in Galloway, Sagadull—Saddle—in Kintyre, Culross, Deer in Buchan, Balmerinoch in Fife, Sweetheart or New Abbey in Galloway, and the one Priory, Mauchline, which was a dependent house or cell of Melrose.[2] As is well known, David I. introduced these Monks into Melrose in 1136, and into Newbotle in 1140.[3] He brought them to Old Melrose,—an ancient religious site dedicated to St. Cuthbert, and his first foundation of this Order,—from Rievalle in Yorkshire. When he founded Newbotle four years afterwards the monks were apparently brought from Melrose to set the new Convent agoing. As has been already noticed, we were, in the twelfth century, in close touch with England in religious matters. The first Cistercian Abbey in England, that of Waverley, was founded only eight years before Melrose.

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[1] It is a pity that the Anglo-Saxon *botl*, a dwelling, has been corrupted in comparatively recent times into the misleading word *battle*. It is still preserved in *Buittle*, Baliol's castle in Kirkcudbright, and *Bootle* in Lancashire.

[2] List annexed to *Book of Pluscarden* (Skene), Vol. I., p. 403.

[3] Lawrie, *Scottish Charters*, p. 379.

The Cistercians carried on within their own Monasteries the industries necessary for the supply of almost all the wants of the community.[1] They were thus nearly independent of outside aid, and there was not the same inducement for traders and craftsmen to settle in the neighbourhood, nor for towns to spring up around the convent walls as there was in the case of other Orders,—such, for example, as the unreformed Benedictines. Hence the establishment of Cistercian houses in sparsely peopled places, such as Dundrennan or Sweetheart or Saddle, did not lead to much increase of population. Their houses were all dedicated to the Virgin. The popularity of such a dedication in the middle ages was a factor which helped the rapid extension of the Order both in England and Scotland.

The Cistercians obtained exemption, by Bull of Pope Alexander IV., from Bishops' visitations.[2] Freedom from the jurisdiction of the Bishop of the Diocese was coveted by the various Orders, and was gradually acquired, of course for a consideration, from Rome.

There are some provisions of the Cistercian statutes which deserve a passing notice as showing the anxiety to cultivate the simple life by which the Order was dominated in its early days:—

"Let there be no towers of stone for bells, nor of wood to an immoderate height, which are unsuitable to the simplicity of the Order."

"Let glass windows be white only, except in abbeys that have been of another Order, which may retain those made otherwise at the time of their conversion."

"Extreme superfluities and quaintness[3] in carvings, paintings, buildings, pavements, and other like things which may damage the ancient integrity of the Order and are not consistent with our poverty we forbid to be made in abbeys, granges and cellarers' buildings, nor any paintings except the image of the Saviour."

"Let twelve monks at least, with the abbot as thirteenth, be sent out to new houses. Nevertheless, let them not be settled there till the place be so furnished with houses, books and other necessaries, that they can live and observe the rule there."[1] It will be noticed that the age which we look upon as superstitious in a marked degree had no prejudice against the number thirteen.

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[1] Cunningham, *Early Industry and Commerce*, p. 72.

[2] Dugdale, *Monasticon* v. 229.

[3] Superfluitates et curiositates notabiles.

Once a year the Abbot of the head-house in each country was called upon to visit the daughter houses, either personally or by deputy, and it was also his duty, unless prevented by sickness, to attend the general Chapter of the Order held annually at Cîteaux. It will be seen that the Order was closely knit together, and thus the house which was first founded in any country occupied an influential position from its priority. In England, Waverley Abbey, founded by William Giffard, Bishop of Winchester, on 24th November, 1128,[2] was the premier Cistercian foundation, and it gave birth within twenty years to no less than seven dependent houses. A Cistercian monastery—a mother house—in those days can be probably best compared to a bee-hive giving off swarms each season.

Newbotle in its site and surroundings illustrates the desire of the Cistercians for peaceful retirement. Situated on the South Esk about two miles south of Dalkeith, it was an ideal spot for a monastery of the Order, which, beyond all others, was devoted to agriculture and the rearing of cattle and sheep. This Abbey had a connection with the West of Scotland, arising through the gift of Carmyle by Herbert, second Bishop of Glasgow, and his Chapter. Malcolm IV. confirmed this grant, and gave the monks extensive additional lands in what became thus after a time known as the parish of Monkland, the old name being Badermanoch.[3] They had a grange at Dunpeldre in this district, and evidently there was much coming and going between their possessions on the Clyde and the monastery on the South Esk, for there are frequent references to the rights they possessed of going through the intervening properties with their wagons and cattle.[4] They held their lands here with rights of free forest,[5] and from many sources, among others a well-known Charter of King David to

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[1] Cistercian Statutes. Ch. I. quoted in Brakspeare, *Waverley Abbey*, p. 4.

[2] *Annales de Waverleia* 75, quoted by Brakspeare, p. 3.

[3] *Crigines Parochiales*, vol. i. p. 51. It was called Monkland after 1323.

[4] *Regist. de Neubotle*, p. 36.

[5] *Ibid.*

Robert de Brus, younger, we learn what extensive rights a much-coveted grant of this kind carried.[1]

The second Abbey mentioned in Silgrave's list is that of Melrose founded by King David in 1136. This house was of the same Order as Newbotle. "The domestic buildings and the Cloister at Melrose were situated, somewhat contrary to the usual practice, on the north side of the Church."[2] There is no hard and fast rule on this subject, but one can readily understand that, in our climate, unless special circumstances (such as the presence of a river) prevented, the warmest side of the Church was preferred, viz., the south.

When speaking of buildings, it may be of interest to mention that in Cistercian Monasteries the frater, after the twelfth century, is invariably built north and south in England. Its position is on the side of the cloisters furthest removed from the church; but while in Benedictine houses it is placed east and west, in Cistercian houses towards the end of the twelfth century a change was made in England, and from that time onward it is found still on the opposite side of the cloisters from the church, but no longer placed east and west, but north and south.[3]

In Scotland, no such careful investigation of the site of any Abbey has been undertaken as that carried out during the last three years, at Waverley, for the Surrey Archæological Society, by Mr. Harold Brakspeare. The results have been recently published, and are of remarkable value.

But to return to Melrose. Its archives, as brought together and published for the Bannatyne Club by the late Professor Cosmo Innes, form a specially fine collection of ancient writs. As it comprises copies of more than a hundred Royal Charters, from David I. down to Robert the Bruce, the editor is right when he says that it "must be regarded with interest by every intelligent student of Scotch history." The claim is amply justified by the Chartulary itself, which, as an indirect exponent of the social life of the period before the War of Independence, is unequalled.

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[1] Lawrie, *Scot. Chs.* p. 413. Robert de Brus, younger, fought for King David at the Battle of the Standard, while the father renounced his allegiance and joined the English barons. The son being taken prisoner by the father was entrusted as a prisoner of war to his mother s care. It was he who complained to his father that he could not eat the bread baked from Dumfriesshire wheat, and got lands in Yorkshire in consequence (*Scottish Charters*, p. 307.)

[2] M'Gibbon & Ross, *Eccles. Arch. of Scot.*, II., p. 347.

[3] Brakspeare, *Waverley Abbey*, p. 49.

Let us open the book at random, say at page seventy-five, and what do we find? A charter by Roger Burnard in favour of the Monks, of one bovate of land in Roxburghshire. In the deed he states the extent of his gift as thirteen acres and one perch of his land in the territory of Faringdun, thus enabling us to check the quantity in a bovate in that part of the country in the time of William the Lyon. Going on to mention the boundaries, the writ gives that on the south as the King's highway *(regia via)* leading to Roxburgh, proving that there were public roads through the land. We know, from another deed,[1] that this King's highway led from Annandale *(de Valle Anant)* to Roxburgh. Then when we come to the tenure we find the property conveyed in frankalmoigne *(in puram et liberam et perpetuam elemosinam)*, free from all exaction, custom, and demand. This, among other privileges, gave the grantees the much-prized exemption from liability to be called on to furnish one or more armed retainers to the King's army. Dr. Dowden tells us that freedom *ab exercitu* was a prevailing advantage of the form of land tenure in the Scottish Church. In England, on the other hand, the absence of this freedom from *suit* and *service* was a heavy burden on the Monasteries. Then, the student who is interested in genealogy finds that our friend Roger Burnard, lord of Faringdun, had four sons at the time—Geoffrey, Ralph, Walter, and Richard—who concur in his gift. Two of the witnesses are John de Mackuswel and Ailmer his brother—interesting ancestors of Sir Herbert Maxwell.[2] The four sons are also witnesses and among others are Alan the Chaplain of Faringdun (in all likelihood a chapel founded by the family on acquiring the manor), and also Simon his grieve, and many others, by whom the land has been perambulated carefully along its boundaries, and these marked off by a trench and rampart made by the Monks in presence of the witnesses. We can trace the sons in subsequent years. I just mention a descendant—Richard Burnand, perhaps a grandson—as appearing in 1252 as lord of Faringdun. In his great need, he sold to the Monks for thirty-five marks, his meadow known as "*Estmedow,*" containing eight acres. The student of land prices has thus something to add to his list of early sales.

This is probably one of the driest charters in the Register of

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[1] *Liber de Melros*, p. 219.

[2] *Scottish Land Names*, p. 180.

Melrose, and yet the dryness disappears when one looks at it as illustrating the social life of the period. Lord Rosebery remarked recently that "Charters are a product which is not agreeable to every palate. They are as caviare to those who do not care about sturgeons' roe." And he went on to say, "I have known two people in this world whom I regard as singular above all human beings; one of whom was a man who read all sermons there was, as we read novels. The other person I can name. I think he was a person who read charters for pleasure," and his lordship named the late Sir William Fraser. Well, Lord Rosebery may be right, but something can be said for charters as reading after all. It depends altogether on how one reads them. Given some imagination to fill in the spaces, and it is wonderful how interesting they become. Then they are generally short, and one reaches the climax before one has time to yawn; and sometimes, especially in French chartularies, instead of names of witnesses,—who always seem to cheer us on our way, as they pop in and out of one charter after another,—we get the most lively curses upon the wretches who may venture to take from what is written, consigning them with Judas the traitor, and Dathan, and Abiron, and other individuals of that stamp, to a place which need not be named, and, worse than all, decreeing that they shall have to pay in addition a hundred pounds of gold.[1]

The Abbey of Melrose has been fortunate in its *sacer vates.* Sir Walter Scott has thrown over its beautiful ruins the charms of his verse. "The character of its architecture,—graceful symmetry, lavish profusion of ornament, exquisite delicacy of workmanship,—has been familiar to everyone since the publication of 'The Lay of the Last Minstrel.'"[2]

On referring again to Henry of Silgrave's List, we find that the third Monastery mentioned is Dryburgh, and the inhabitants are called White Canons. The Cistercian Order, as we have seen, was a modification of, or offshoot from, that of St. Benedict, but here we are introduced to a distinct Order, with its own historical development. Founded at Metz, in the eighth century, by Bishop Chrodegand, the Order of Canons Regular flourished, and from being at first attached to a Cathedral gradually spread to other places as an order of regular clergy living in monasteries.[1]

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[1] *Cartulaire de Savigny, 1re parti,* p. 468.

[2] Robertson, *Scottish Abbeys and Cathedrals (Quarterly Review,* Vol. 85, p. 140).

The Convent at Dryburgh belongs to the second division of Canons Regular—the Premonstratensian or Norbertine, or White Canons. The White Canons had six houses in Scotland—(1) Souls' Seat; (2) Holywood, sometimes known as Dercongal; (3) Whithorn or Candida Casa, and (4) Tungland—all in Galloway, the land of St. Ninian; (5) Ferne, in Ross shire, and (6) Dryburgh on the Tweed.

We may recall the fact that the Austin Canons had seven important Abbeys, besides upwards of a dozen well-known Priories, in our midst. Of these, the outstanding importance of St. Andrews is familiar. Its Prior held a pre-eminent position among the regular clergy of Scotland. Its chartulary, published in 1841, among other services to historical studies, was the first solid foundation for a true view of the Culdees.

The Abbey at Scone,—re-founded by Alexander I., and at first only a Priory,—belonged to this Order. The Monks were brought from St. Oswald's, near Pontefract, to establish it.

We next come to a very interesting religious foundation: the Monastery of St. Mary of Kelso, founded for Benedictines from St. Bernard's Abbey of Tiron, in le Perche, France, and hence known as Tironenses.

The Benedictines from Tiron had several noted houses in Scotland: Kelso, Kilwinning, Arbroath, and Lindores—all Abbeys of the first rank—and also two important Priories, Lesmahago, an offshoot of Kelso, and Fyvie, a cell of Arbroath.

The mother house of Tiron, dedicated to the Holy Trinity, has special interest for us. It was largely endowed from English revenues, by Henry I., as Mr. Round points out in his Calendar. Henry was our King David's brother-in-law, and, as they were good friends, David followed his example by favouring this Monastery also. So did his niece, the Empress Maud, and his son Henry, Earl of Northumberland. King Henry sent his nephew, the Count of Blois, and his son-in-law, the Count of Perche, to St. Bernard to beg him to pay him a visit in Normandy. The holy man acquiesced, and a warm friendship, the result of the visit, sprang up between them. Hence the English, and following them the Scottish, gifts to the Monastery. When kings or queens lead the way, lesser folk follow. Thus one may note in passing a gift by Alan, Seneschal of Dol, in Brittany, ancestor of our Stewart Kings. Bishop John, King David's first Bishop of Glasgow, it will be remembered, retired to this Abbey when he grew sick of contention with the Archbishop of York regarding the ecclesiastical pretensions of the latter over Scotland and its Bishops.

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[1] It is usual to divide the Canons Regular into (*a*) Augustinian, also known as Black Canons, (*b*) Premonstratensian or Norbentine, known as White, and (*c*) Gilbertine. Early writers distinguish between Monks and Canons. Thus Robert of Brunne, singing the praises of Sir Walter Espec, says:—

> Walter Spek was in that stoure, gode knyght at alle nedes.
> The boke tellis grete honoure of his douhty dedes,
> Of monkes and chanones he did mak abbeis,
> Wis man in the lawe, knyght gode and curteis.

The Abbey of Kelso, founded by Earl David (first of all at Selkirk) before he was King, and very richly endowed, became perhaps the foremost Monastery in Scotland. Its Register, published in 1846, reveals very large possessions—fifty-two different estates are mentioned in a Roll or Inventory of the lands and Baronies; and the Spiritualities,—or Churches and dues payable from Churches,—number thirty-eight. This Roll is of a date before the close of the thirteenth century. On turning to the Register itself we find it full of instruction regarding the ways of man in early Scotland. Let us take the following short letter of King William the Lyon:[1] "William, by the grace of God, King of the Scots, to all good men of my whole land, clerics and laymen, Greeting: I command and strictly enjoin that wherever the Prior of Lesmahago or his servant, the bearer of these presents, may find, even beyond my dominions, his serfs *(nativi homines)* fugitives from Lesmahago, he is to have them justly restored; and I strictly prohibit all men from wrongfully detaining any one of them, under pain of plenary forfeiture. Witnesses—Robert de Quenci, Walter of St. Albans, my Chaplain. At Lestalrig, the 6th day of May." Here we are introduced to Serfdom in Scotland, and this is one of many writs scattered through the Monastic Registers dealing with *nativi* or 'neyfs.' One may recall the action of the Church in the gradual emancipation of this class, attached to the grange in Scotland, along with the cattle, farm implements, and stores required for the cultivation of the ground, and thus liable to be transferred with the land. The Scottish Monasteries, as great landowners, had, almost from the beginning of their history, to deal with these "natives," and in David I.'s time there are several Royal Charters on the subject.

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[1] *Liber de Calchou*, II., 312.

It was during the incumbency of Herbert, the third Abbot, that the change of situation from Selkirk to Kelso occurred. This step was taken on the advice of the Bishop of Glasgow, who had been King David's tutor, and was evidently much interested in the welfare of the Monks from Tiron. The bond between the Monastery and the See of Glasgow was very close at this time, and on the death of Bishop John, Abbot Herbert was chosen to succeed him. The New Abbey Church at Kelso had been founded in 1128, and the Abbot was consecrated Bishop of Glasgow nineteen years afterwards. His successor in the Abbot's chair, Abbot Arnold, became in 1160 Bishop of St. Andrews.[1] Thus the early Abbots were important ecclesiastics.

Time forbids us to speak of the Cluniac Benedictines, with their Abbeys at Crossraguel, Iona, and Paisley,—the last of these "one of the four principal places of pilgrimage in Scotland," and, with its large estates in the West, a valuable promoter of agriculture and trade.

It would be unpardonable, however, to omit all reference to the Military-Monastic Foundations, *i e.*, Knights Templars, and Knights Hospitallers, and also to the Friars.

The latter, early in the thirteenth century, invaded Scotland; and their zeal and unconventional methods, coupled with their self-imposed poverty and self-abnegation, caused them to be very favourably received by high and low. King Alexander II. extended his patronage towards both the Franciscans and Dominicans, and they quickly were established in many of the more important towns. Their houses, notwithstanding vigorous efforts to retain early simplicity, tended to become more and more substantial and extensive, and the inmates more devoted to the good things of this life, as the wealth which it was against the rule to handle came flowing in. In this way the orders of mendicants laid themselves open to the attacks of the satirists, but this did not take place in the period under review.

Such a description as the following in the fourteenth century, would have been impossible during the thirteenth :—

"I fond in a freitour a frere on a benche
A greet cherl, and a grym growen as a tonne,

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[1] At Kelso, the Monastery was in the Diocese of St. Andrews—not Glasgow, as is often represented. The River Tweed was the boundary between the Sees. (See Lawrie, *Scot. Charters*, pp. 68, 332.)

With a face as fat as a full bledder,
Blowen bretfull of breth, and as a bagge honged
On bothen his chekes, and his chyn with a chol lollede,
As greet as a gos eye, growen all of grece;
That all wagged his fleche, as a quyk myre."[1]

And yet all generalizations are inadequate amid the complexity of human affairs. We need hardly remind you that the greatest of our dramatists can speak of a Franciscan friar as being

. . . "A brother of gracious Order."

And again as

. . . "A man divine and holy,
Not scurvy, nor a temporary meddler."[2]

Reference must be made very briefly to the Templars, and their colleagues-in-arms and eventual heirs, the Knights-Hospitallers.

Ailred, in his "Lament on King David's Death," makes the statement that "the King committed himself altogether to the guidance of monks, and attached to himself the most noble brethren of the distinguished Knighthood of the Temple of Jerusalem, and made them by day and night the guardians of his morals." If the latter part of this sentence is true, all that can be said is that the King's morals were not in the best of keeping. For pride and overbearing conduct were certainly characteristic of the Knights Templars, and there exists charter-evidence that in Scotland they played a sinister part shortly before their final suppression. The Monks were a powerful force in favour of peace, but this cannot be said of the Templars nor of their Master in England, Brian de Jaye, who was, as is well known, slain at Falkirk in 1298, fighting for the English. If we can trust the narrative of a Scottish Charter of 1354, he was an oppressor of the widow and fatherless, and capable of planning and carrying out the brutal murder of an unsuspecting countryman, who was acting as guide to his troops in the Wood of Clerkyntoun. Altogether, his picture, as it has come down through the centuries, is as black as it can be painted.

If the Templars, at their preceptory at Balantrodach, in Midlothian, have left behind them an evil reputation, one is pleased to be able to say that the kindred Order of the Hospital of St. John of Jerusalem, which also came into Scotland in the reign of King David, has a much more favourable record. The student who traces its career down the later middle ages in our country will come to the conclusion that, wanting the distinguished preceptors who ruled with energy at Torphichen in later times,—such as Sir William Knollis, Sir George Dundas, and Sir Walter Lindsay,—we would have been distinctly poorer. They are disclosed to us in contemporary documents as not only statesmen and warriors, but pioneers in agriculture, trade, and commerce,—men of force of character and varied attainments. When the Monks and Friars were falling into contempt, the Knights of St. John were still in high favour in many quarters. In the "*Testament of Squyer Meldrum*," the Lord of St. John is named as one of the three executors, and in very laudatory terms. The testator, however, as a man of war from his youth, wishes his bier to be accompanied by "ane band of Mars, his religioun":—

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[1] *Pierce the Ploughman's Crede* (E.E.T.S.), p. 9. The relations between the Seculars and Regulars, often strained, to use no stronger term, are not touched upon, for this reason, that the topic would require a paper to itself in order to do justice to it.

[2] *Measure for Measure*, Act iii. Sc. ii., A.v. s. i.

[3] Fordun, *Chronicle* (Skene) I., p. 242.

> "That is to say, in steid of monkis and freiris,
> In gude ordour ane thousand hagbutteris."[1]

This is two hundred years later than our period, and therefore not to be taken as condemnatory of the Monks and Friars of the thirteenth century.

When a comparison between the number of Religious Houses north and south of the Border is made, one sees the smallness of Scotland as compared with England,—smallness not only in extent but in material resources. Before the War of Independence we had all the Religious Orders of importance to be found in England, except the Gilbertines,—who had retired in the year 1238, from Ayrshire,—but the numbers are very different. About one hundred and thirty houses for men and rather more than twenty for women make up the total. As compared with England, with upwards of eight hundred houses, large and small, including Nunneries, at the time of the suppression, our number is insignificant, being less than one-fifth. Our land had and has a somewhat rigorous climate in winter, not to speak of our uncertain summers. The life of the Monk in his cloister was passed in the open air, and one does not wonder if, notwithstanding all the heavy clothes he wore, he still often felt the cold winter winds piercing through his garments, and finding out the weak places in his constitution.

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[1] Lindsay, *Works* (Laing), Vol. I., p. 214.

In Northern Europe, including Britain of course, the normal position of the cloister was to the south of the nave of the church. Protected thus on the east by the south transept, and on the north by the high walls and roof of the nave, it was sheltered from the cold winds, and being open to the sun it got all the natural warmth that was going; but we know that there are many days from November to March when that cannot count for much. The Abbot and Convent of Lindores approached the Pope in the thirteenth century, petitioning for permission to wear caps on certain solemn festivals. They state that Scotland is a cold region, and that some of the Monks had suffered from being bare-headed. The request was granted. We hear less, however, than one would expect regarding the cold of winter. Frequent mention is made of storms, thunder and lightning. Failure of food supplies from bad harvests is often chronicled. The Monks felt the pinch as well as others, and they recorded the famine prices of provisions in their annals. We read, for example, in the Chronicle of Lanercost, under date A.D. 1293: "There was in this year throughout all England and Scotland so great scarcity of corn that a quarter of wheat in many places was sold for thirty shillings."[1] Again, "And that tyme[2] byfelle manye meschiefs in Englande; for the pouer peple deide in Engelande for hunger, and so moche and so faste folke deide that unnethe men myghte hem beryen. For a quarter of whete was worth xl*s*., and two yere and an half a quarter of whete was worth ij. marcs. And ofte tymes the pore peple stalen childeren and eten hem, and eten alle the houndes that they myghte taken, and eke hors and cattes."[3] Small wonder if famine such as this made a deep impression on the monastic chroniclers!

In the middle ages the shadows are dark, and they fall with startling suddenness; but there are frequent gleams of light, and the dark clouds have their silver lining, then as now.

The Monasteries and other Religious Houses in Scotland, among a people and at a time when, to a large extent, war was the occupation of the nobles, were of great value as centres of religious influence. They made for three things,—they held aloft three principles which were liable to be overlooked in early times. These were: Peace, Learning and Freedom.

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[1] *Chronicle of Lanercost*, p. 154, Thirty shillings a quarter is an enormous price. One must multiply by ten at least in order to get an equivalent in our money.

[2] The period is immediately after Bannockburn.

[3] MS. *Chronicle of Brut*, fol. 87.

As to Peace: One can readily see the influence which a body of men like the Monks and Friars, when they were in earnest, must have exercised. Each house was a centre from which the doctrines of Christianity, brotherly love, and consideration for one's fellows, emanated and spread over the country. It is true that there was often much dross mingled with the fine gold, but still there was a residue of genuine metal. In the eleventh and twelfth centuries the Monks were popular, and it was no unusual thing for a warrior in his old age to throw off his armour, and, putting on the habit of one or other of the great Orders, to prepare to meet the end of this mortal life within the convent's walls.[1]

In addition, the Monasteries promoted peace by cultivating intercourse between the different nations of Europe. For example, there was continual coming and going between the mother houses of Citeaux and Prémontré in France and their daughter houses in Scotland. The first Abbot of Kelso was Ralph, one of the thirteen Reformed Benedictines brought over by Earl David in 1113, from Tiron, in Le Perche. He, in his turn, is said to have succeeded St. Bernard, in 1116, as Abbot of Tiron, although this statement lacks confirmation.

The Monasteries furthered the cause of peace also by their commercial relations with foreign lands. They were in early times pioneers in agriculture and commerce. In a poor country it was of great importance to have landlords like them, who had both enterprise and capital, and correspondents in Europe willing to take their exports of wool and hides. In this connection Dr. Cunningham, in his learned work on the "Growth of English Industry and Commerce,"[2] has printed a most interesting document. It gives a list of English and Scottish Religious Houses, exporters of wool to Flanders. Being an Italian list, it probably owes its existence to "some effort to divert a larger share of English-grown wool to Italy."[3] Among the Scottish Abbeys mentioned under the heading "Inghilterra," are Niobottoli (Newbotle), Mirososso (Melrose), Chupero (Cupar-Angus), Donfermellino (Dunfermline). Dondarnane (Dundrennan), Grenellusso (Glenluce), Il tenpo di Bratendoccha (Balantrodach). Our Scottish place names are so twisted that several have hitherto baffled all attempts at identification. In the inclusion of about fifteen Scottish houses, we have direct testimony to the fact that the northern trade was being looked at with a longing eye by our Italian friends.

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[1] To take a single instance: The Lord of Monmouth, Guienoc by name, in the time of William the Conqueror, gave large grants of land there to the Benedictine Abbey of St. Florent Saumur, and we find that he afterwards appears in the records of the Monastery as one of the Monks.—*Calendar of Documents*, France, I., 407.

[2] Cambridge, 1905. [3] Cunningham, *Op. Cit.* p. 628.

Then the right of Sanctuary attaching to monastic churches was an element which in early times made for peace. Sometimes an important house, whose patron Saint was held in high veneration, had a Royal Charter to strengthen the Sanctity of its shrine. Thus Lesmahago, a cell of Kelso Abbey, had this privilege conferred upon it in express terms by David I. His words are—"Whoso, for escaping peril of life or limb, flee to the said cell, or come within the four crosses that stand around it, of reverence to God and Saint Machutus, I grant them my firm peace."[1] A grant such as this added much to the safety of a fugitive who reached within the girth stones.

The monks and friars were the students and learned men of the age. Beginning as simple missionaries with a certain distrust of learning, they soon found that they could not get on without it. Even in the eighth century Alcuin was helping Charlemagne in his reform of education. They were the schoolmasters. We know of no lay teachers in Scotland before the Reformation. From their ranks were drawn the diplomatists, statesmen, and officials. They were the lawyers to a large extent, and had the making of wills and settlements, and of course did not forget their own Order when doing so.

In addition, they were pre-eminently the annalists and historians. Their labours in preserving a record of medieval history entitle them to the gratitude of later ages. For many periods our knowledge would be almost a blank but for monastic chronicles. Each large religious house had its own manuscript book of annals known by the name of the house, hence we have the Book of Cupar, the Book of Pluscarden, the Black Book of Paisley, etc., not independent histories, but adaptations, in most cases, of Fordun.

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[1] *Liber de Calchou*, xxiii.

It is the same elsewhere. In France and England the monastery was the medieval *école des chartes*, and it turned out men who were often a credit to their training. So much a credit that they could, when so minded, forge a charter, which, on the question of its genuineness, would divide experts at the present day into two parties.

The monks, as ecclesiastics, were in favour of freedom in many ways. It was alien to the spirit of Christianity to possess slaves. Hence we find from the registers that the religious houses gradually freed such slaves as they acquired by gift from time to time. The last recorded instance of bondage in Scotland, except in the case of colliers and salters, is towards the close of the fourteenth century. In charters of the eleventh and twelfth centuries, as we have seen, many references to serfs in Scotland occur. Their names are given, and they are bought, gifted and sold along with the land in the most matter-of-fact way. These "nativi," judging from their names, *e.g.*, Gillandreas MacSuthen, Gilmory Gillendes, Gilchrist Roch filius Gilleththeny, seem to have been in most cases original inhabitants of Celtic race. In a few instances they may have been prisoners of war who were unredeemed.

In an age when people moved about a great deal, and in what we would look upon as a leisurely fashion, accommodation for travellers throughout the country was of great importance. The monasteries and friaries supplemented the inns of the early middle ages. There the wayfarer was sure to find entertainment both for man and beast. The Cistercian monasteries usually had at least two houses for the reception of guests,[1] and very generally a secular infirmary quite distinct from that of the monks for the care of the sick and those travellers who might take ill during a journey.[2]

Except in case of sickness a guest's stay in a monastic establishment was limited, he was expected to move on in three days. When dealing with a powerful noble, it was doubtless difficult to enforce the rule, and complaints are common in the accounts of all houses, of the undue cost of hospitality. In one instance the head of the house is hardly moderate in his language. He says:—"Travellers overflow upon us from day to day, and are great devastators, and are a grievous burden (inponderosi)."[1] Thus were the virtues of the devout taken advantage of by unscrupulous men!

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[1] Brakspeare, *Waverley Abbey*, p. 75.

[2] There were secular infirmaries at Meaux, Pipewell, Newminster, and Furness, and also at Waverley. (Brakspeare, *Waverley Abbey*, p. 83.)

In the early history of Scotland Latin monachism appears as a power making for good. It combined labour with prayer in due proportion, and was for the pious and studious a refuge from a turbulent and unstable world. But the world could not be left behind at the monastery gates, and all the rules and reformed statutes promulgated by the different orders and by church councils from time to time did not avail to drive out the flesh and the devil. The influence of the life and character of the saintly founder kept for a time the Order of St. Francis at a high level, but gradually other forces appeared and dragged even his followers down. And this was true of the religious orders as a whole. Hence they fell in our land as elsewhere.

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[1] *Hospitallers in England*, p. 35.

Statistical Studies in Immunity. The Incubation Period and the Crisis. By JOHN BROWNLEE, M.A., M.D., Glasgow, Physician Superintendent, City of Glasgow Fever and Small-pox Hospitals, Belvidere.

[Read before the Society, 7th November, 1906.]

IN the present paper it is intended to discuss a few of the facts concerning incubation periods and the days of crisis in different diseases in relation to questions of immunity. Unfortunately data referring to large numbers of cases are not readily obtainable even in the records of a large infectious diseases hospital. In some diseases such as typhus fever the most recent text-books give practically no incubation data, and even in Glasgow where this disease is still present to a small extent, and where therefore the conditions to determine the facts are most favourable, the number of instances in which the incubation period can be fixed from a single contact is so small as to make the figures useless for statistical purposes. Other diseases such as Measles are very infectious for a certain number of days before definite diagnosis is possible, and in this case the number of instances in which the incubation period can be fixed within 24 hours is surprisingly small. Two diseases alone, namely varicella and variola, have been found to furnish good data for the present purpose. Of the former I have been able to collect the incubation periods of sixty-five cases, and of the latter forty-six. In the case of the former I have seen no evidence that patients incubating it possess any infectivity prior to the appearance of the symptoms. Twice it has happened that children have been transferred from wards on the day prior to the appearance of a varicellar eruption without the subsequent development of the disease in the wards from which they were removed. The characteristic rash in most cases is the earliest symptom. In consequence as a considerable number of children suffering from other diseases are admitted to the hospital incubating this disease, unknowingly placed among susceptible persons, and removed on the first appearance of the new illness, all the conditions necessary for the accurate determination of the incubation period are present. Variola also affords a considerable amount of data. In the recent epidemics in Glasgow in all forty-six persons were ascertained to have visited persons suffering from the disease on a single occasion, and so far as could be discovered to have been exposed to no other source of infection. Many of these developed the disease in districts of the city in which no other cases were known to exist, thus fulfilling the necessary criteria.

In Scarlet Fever and German Measles a certain number of incubation periods have also been ascertained in the hospital. For further details the Report of the Clinical Society of London on this subject has been consulted, but the chief additional data used have been those recorded by Dr. Dukes, Physician to the Rugby School.[1] These have been ascertained under the same conditions as my own figures, are liable to the same sources of error, and when considered separately show a general concordance.

One other source for the study of incubation periods in large numbers has been afforded in recent years by the serum treatment of diphtheria, and in this case a large body of statistics of considerable interest has been accumulated.

For the determination of a number of points, the data concerning varicella and variola are the most complete. For varicella the accompanying table shows the number of cases which have developed on each day after exposure to infection, and it is seen that the shortest time at which chicken-pox has developed in the hospital cases is eleven days after infection, and nine days in those of Dr. Dukes, while the greatest number sicken fifteen days after exposure. After the twenty-four days no case has been observed to occur. It is to be noted that the progression from a few cases developing eleven days after exposure to the maximum and thence to the decline to zero is fairly continuous, but the numbers occurring after the incubation period of 11, 13, 15, and 17 days are much larger than those after 10, 12, 14, and 16 days, a fact perhaps to be explained by the existence of some such condition as a two day stage in the life history of the organism. The numbers are however too small to make this inference certain. A further point of importance is observed when the different groups of cases occurring in each separate infection is considered. It

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[1] *Lancet*, 1881, October 29th, p. 743, and 1899, April 29th, p. 1147.

TABLE I.—Table showing the incubation periods of cases of Varicella, Variola, German Measles and Mumps in groups where a number of persons were infected after exposure on a definite date, and collectively where only one secondary case occurred. Those marked D are recorded by Dr Dukes.

NUMBER OF CASES DEVELOPING AFTER . . . DAYS OF EXPOSURE.

Name of Disease.	No. of Group.	Days after Exposure.																	Total.
		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
VARICELLA or CHICKENPOX.	1	...	...	...	2	1	...	1	...	...	...	...	...	...	...	...	...	...	...
	2	...	...	...	...	2	2	...	...	...	...	...	...	...	...	...	...	...	...
	3	...	...	...	...	...	2	...	1	...	...	...	...	...	...	...	...	...	...
	4	...	...	...	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...
	5	...	...	...	...	...	...	1	2	1	...	...	...	...	...	...	...	...	...
	6	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...
	7	...	...	...	...	...	...	1	4	...	2	...	...	...	...	...	...	...	...
	8	...	...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...	...
	9	...	...	...	...	...	...	...	1	...	...	2	...	...	...	...	...	...	...
	10	...	...	...	...	...	...	...	2	...	1	...	...	...	...	...	...	...	...
	11	...	...	...	...	...	...	...	...	5	...	...	...	...	...	...	...	...	...
	12	...	...	...	...	...	...	...	...	...	5	...	...	...	...	...	...	...	...
	13	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...
	14	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...
	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	1	...
	Others	...	...	...	1	...	2	1	...	1	...	2	1	2	1	1	...	...	...
	,, D	...	1	...	...	...	3	2	8	3	3	2	3	...	...	...	...	...	...
	Total,	...	1	...	3	3	10	9	21	10	14	6	5	2	1	4	...	1	90
VARIOLA or SMALLPOX.	1	1	...	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	2	...	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	3	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...
	Others	2	2	4	8	4	5	6	1	1	...	...	...	...	...	...	...	...	...
	Total,	3	4	8	10	8	5	6	1	1	...	...	...	...	...	...	...	...	46
RÖTHELN or GERMAN MEASLES.	1	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...
	2D	...	...	...	...	1	...	2	...	...	...	...	...	...	...	...	...	...	...
	3	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...
	4	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...
	5D	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...
	6	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...
	7D	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...
	8D	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...	...	...
	9D	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...
	10	...	...	...	...	...	...	...	...	...	...	3	3	1	...	...	...	...	...
	11	...	...	...	...	...	...	...	...	...	...	...	3	1	...	...	...	...	...
	Others	...	...	...	...	1	1	4	1	2	1	...	...	1	...	...	...	...	...
	Total,	...	...	...	...	3	1	10	2	11	3	5	6	3	...	...	...	...	44
PAROTILIS or MUMPS. Dr DUKES.	1	...	...	...	...	...	...	1	...	1	...	...	1	...	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	1	...
	3	...	...	...	...	...	...	...	...	...	3	...	...	1	...	...	...	...	...
	4	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...
	5	...	...	...	...	...	...	...	...	...	2	3	...	2	...	...	...	...	...
	6	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...
	7	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...
	8	...	...	...	...	...	...	...	1	...	...	...	4	1	...	...	...	...	...
	9	...	...	...	...	...	...	...	...	...	...	...	3	1	...	...	...	...	...
	10	...	...	...	...	...	1	...	...	...	1	...	...	2	4	...	...	...	...
	11	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...
	Others	...	...	...	...	...	...	...	1	1	4	4	6	1	1	1	1	1	...
	Total,	...	...	...	...	...	1	1	2	3	11	10	17	8	6	2	1	2	64

will be seen by a reference to Table I. that when a number of persons are infected from the same source at the same time there is very little variation in the incubation period. Each group of infected persons is tabulated so as to show the numbers who sickened on each day after exposure. In no group does the length of incubation vary more than three complete days, although the incubation period of all cases of chicken-pox has a range of fourteen days. In other words the incubation period in any definite infection depends far more on the individual peculiarities of the germ infecting than on the constitutional peculiarities of the person infected. This is a very important point, and is in direct accordance with what we know of many properties of different races of the same organism when examined *in vitro.*

With smallpox in the same way may be seen in Table I the general manner in which the incubation varies from the period of infection till the onset of the initial sickness. The range is not nearly so great as in chicken-pox, nor is there any evidence of the existence of a bi-daily period in the life history of the organism.

In this disease only three groups of infection disseminated at the same instant among a variety of persons, have come under notice. In two of these a child with a confluent eruption of smallpox was taken to a public dispensary, and in the third a whole family was exposed to infection on a definite date with the result that five members sickened. Again it is to be observed (Table I.) that the date of sickening in these cases varies much less than the total range of incubation. The limit of variation is the same as that for chicken-pox, namely three complete days.

In Table I. the incubation periods of mumps, scarlet fever, and German measles are also given. In all these instances it is to be noted that the range of duration of the incubation period differs little in each group compared with the total range. The greatest diversity is seen in the case of mumps, but even in this, only in three instances out of eleven does it exceed a very few days. It is apparently, so far as can be ascertained by the tables at our disposal, a fact that in general some quality of the infecting organism is the main cause of the length of the incubation period. It is to be noted that the figures for German measles or rötheln also gives some indication of a two-day period in the life history of the infecting organism.

The influence of the age of the patients on the incubation period does not seem to be very great. Dr. Dukes, in his papers already referred to, has expressed this opinion, and in the accompanying table (Table II. A) it will be seen that this conclusion is also true for most cases of chicken-pox, while in the case of smallpox (Table II. B) it is found that the average incubation period for

TABLE I. A.—THE SAME FOR SCARLATINA.

No. of Days.

	-1	1	2	3	4	5	6	7	8	9	10
1 D	...	2	...	...	...	...	...	...	...	...	...
2 D	...	1	1	...	...	...	...	...	...	...	...
3 D	...	...	...	3	...	...	...	...	...	...	...
4	...	...	...	1	1	1	...	...	...	...	...
5 D	...	..	...	...	2	...	..	...	...	...	...
Others D	1	1	1	1	...	2	1	...	1	...	...
Others Dr. Murchison . .	1	...	1	1	...	...	...	...	...	...	...
Others . . . . :	...	1	1	1	...	...	...	...	...	...	1 ?
Total	2	5	4	7	3	3	1	...	1	...	1 ?

TABLE II. A.

Incubation Period of Chicken-pox Relative to Age.

Years of Age.	No. of Cases.	Mean Incubation Period in Days.
-1	3	16·6
1-2	10	16·4
2-3	6	18·3
3-4	18	15·7
4-5	10	16·0
5-6	5	13·6
6-7	7	15·7
7-8	1	15·0
8-9	3	14·1
9-	2	15·5

those patients suffering from smallpox above twenty-five years of age is within a fraction of a day the same as the average for those below twenty five. No distinction between the patients as regards age has therefore been deemed necessary in this discussion.

In regard to the length of the incubation period being dependent

TABLE II. C. TABLE II. B.

Incubation Periods in Cases of Smallpox

Number of Days from Infection.	CHARACTER OF CASE IN Vaccinated. Confluent.	Abundant.	Sparse.	Unvaccinated. Confluent.	AGE OF PATIENTS IN Vaccinated. < 25 Years.	> 25 Years.	Unvaccinated. < 25 Years.	> 25 Years.
8	...	1	2	...	...	3	...	...
9	...	...	4	...	3	1	...	...
10	2	3	4	...	4	4	...	...
11	...	3	7	...	4	6	...	..
12	2	1	5	...	3	5	...	...
13	...	2	3	...	3	2	...	...
14	...	1	4	1	...	5	1	...
15	...	1	...	...	...	1	...	...
16	...	...	1	...	...	1	...	...
17	...	...	...	...	...	...	...	...
Mean	11	11.5	11·3	14	11	11·7	14	...

on the infecting organism, it is important to know if this is a permanent quality of a particular race of an organism or a quality which may vary in succeeding generations of the same organism. All the cases bearing on this which I have been able to collect are given in the accompanying table (Table III.), and it is apparent that while the period of incubation of successive groups of cases infected by the same organism is fairly constant, yet the correspondence is not so absolute as to warrant the conclusion that the incubation period, which in each individual case is dependent on the state of the organism at the moment, remains in a sequence of the infections also constant in a like manner. In other words, the length of the incubation period is not a property which is inherited in an absolute manner. Out of the twelve cases given in the table the incubation period is hereditary in ten, but in the other two considerably different, or at least different to an extent beyond the limits of the three complete days which were found to hold in the cases previously considered.

Another important point is the relation of the incubation period to the severity of the attack, Unfortunately here again is a very great difficulty in obtaining evidence. With regard to chickenpox differences of severity can hardly be recorded, while with regard to smallpox the modifying effect of vaccination must be taken into account. With the small number of cases at our disposal the latter is impossible. When the cases are tabulated according to degrees of severity of attack, no difference is observed between the mean incubation periods of the different groups, an observation somewhat contrary to the usual belief, but this will receive some confirmation in a later part of this paper. In the actual groups, where several persons were infected at the same time, there is likewise no evidence that there is any association between incubation period and severity, and in the instance where four persons sickened on the same day after exposure, in two of these the eruption was sparse, in one abundant, and in the fourth confluent, although the patients presented no great difference either in their age or in the character of their vaccination (Table II. c).

It must be evident from what has been said that unless incubation periods are collected over a considerable space of time and in different epidemics, or unless these statistics of different epidemics are compared only among themselves little trust can be placed on the statement that severe cases are in general associated with short incubation periods. As has been seen the particular

TABLE III.—Table showing the duration of the incubation period in second infections by the same organism. In the Chicken-pox cases the infection in the second group is counted as from the first case in the first group.

Disease.	Group.	Days after exposure at which disease developed. First generation.											Days after exposure at which disease developed. Second generation.											
		12	13	14	15	16	17	18	19	20	21	22	12	13	14	15	16	17	18	19	20	21	22	
CHICKEN-POX.	1	...	...	1	3	1	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	...	x
	2	..	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	2	..	...	1	...	x
	3	...	...	1	...	...	...	1	...	...	...	..	...	...	...	...	1	...	...	...	1	1	...	x
	4	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	5	...	...	...	...	...	x
	5	...	...	...	2	...	1	...	...	...	...	...	4	2	3	2	...	...	...	...	...	...	...	o
	6	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	1	2	...	...	...	...	...	x
	D7	...	...	...	1	...	...	...	...	...	...	...	...	...	...	2	(14-16	days)	...	...	...	...	...	x
RÖTHELN.	D1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	x
MUMPS.	D1	...	...	...	...	...	...	1	...	..	...	...	...	...	...	...	...	...	1	1	...	...	...	x

Disease.	Group.	1	2	3	4	5	6	7			1	2	3	4	5	6	7	
SCARLET FEVER.	D1	...	...	...	1	...	...	....			...	.	...	...	2	...	...	x
	D2	...	...	...	...	1	...	...			...	1	1	...	8	...	...	o
	D3	...	...	...	1	...	...	...			...	2	...	...	...	...	...	x

x Those marked thus are in favour of the inheritance of the incubation period by the germ.

o Those marked thus show divergence from this property.

organism has the chief part in determining the incubation period. With regard to smallpox, Zülzer is constantly quoted to the effect that hæmorrhagic smallpox has a shorter incubation period than other cases. Counting to the appearance of the eruption this is possibly true, but counting to the onset of symptoms, as has been done in my figures, the evidence is not comp'ete. I have not seen Zülzer's original paper, but the synopsis in Virchow's Jahrbuch does not suggest that the evidence is conclusive.

One consideration demands mention here. The whole body of phenomena associated with the incubation period just detailed will be found a little later to have a very marked analogy with the phenomena displayed by the duration of the disease in the infected organism. The same kind of distribution is noted, and it strongly suggests that the incubation period represents to some extent a disease of the attacking organism which it must survive before itself is capable of producing disease in its host; in other words, it must manufacture anti-bodies for its own protection before it can proliferate to a sufficient extent to cause an attack of disease.

A second group of cases of incubation periods now falls to be considered. In this the cause of the illness, in place of being the toxin produced by an infecting agent, appears to be a secondary substance produced after a foreign body not toxic in itself has been introduced into the system, by the development of an anti-body which either forms a toxic combination with the original substance or produces a break down of this into toxic substances. The disease in this case is then an accident due to the organism utilising its ordinary methods of defence against substances for which the process has not originally been designed.

Such a condition is produced when horse serum is injected in the treatment of diphtheria. In this case we have absolute data based on numbers of cases much in excess of what are procurable in the case of the ordinary infectious diseases, and also much more correct, for both the date on which the foreign substance is administered and the amount are definitely known. In close connection with this class of poisons are those associated with some of the complications of the specific fevers which are evidently due to substances altered in much the same way either by combination or break down. Chief among such are the arthritis and nephritis of scarlet fever. In this class also the paralysis following diphtheria is probably also to be included.

The exact incubation period, however, is not so definite in these instances, as the substance subsequently made toxic is produced at a period of the disease of which we are ignorant, and the onset of the fever must in consequence be taken as the date from which the incubation has to be calculated.

Certain theoretical difficulties present themselves at this point. While it is moderately obvious that the serum fever must be due to an alteration in some substance contained in the serum, which is itself not poisonous, it is not at all clear whether the altered substance is one which demands the elaboration of a new series of anti-bodies before it can finally be eliminated, or whether the same agents already formed which have begun the destruction of the non-toxic substance are themselves sufficient to complete its destruction. In the former case there will be an almost complete analogy between the serum fever and an ordinary specific fever, though the serum fever is really an auto-intoxication, while in the latter there is sufficient difference to demand caution in the application of results obtained from a consideration of serum fever, to the other forms of disease. With all the drawbacks the large numbers available makes the statistics of very considerable value. The cases on which the figures are based consist practically wholly of children, and in consequence the material presented is moderately homogeneous. Again, Table IV. shows that if the dose of serum be higher than 6000 units neither size of dose nor type of case makes any difference in the frequency with which the rashes occur. In this table all cases which lived for nine days before death in whom no rash developed prior to that date are included among the negative figures. Such cases were very few, most deaths occurring within nine days of admission to hospital. This undoubtedly makes a slight difficulty in estimating exactly the effect which the severity has upon the likelihood of the rash developing, but the figures on which the results are based are otherwise so homogeneous that it does not seem necessary to make any special inquiries into the effect of this. These facts are to some extent different from what have been recorded by other observers, both in the frequency with which rashes occur and in the absence of effect on their frequency produced by the character of the case. But these matters must be subject to a good deal of variation in different places due to difference of race.

In Table V. the total rashes are classified in the numbers in which they occurred on each day after inoculation. Where two

TABLE IV.—Showing the frequency of rash after serum administration according as the cases are divided in relation to the amount of antitoxin administered and also as regards the severity of the attack of diphtheria.

AMOUNT OF ANTITOXIN IN UNITS.

	3000-6000	-9000	-12,000	18,000	-30,000	30,000-	Total.
Numbers with Rash	2	29	64	89	52	12	248
Do. without Rash	8	26	58	75	42	6	215
Relation to Severity[1]	Mild.	Mod.	Severe.	Very Severe.	Intra-venous.	Other Diseases	Total.
Numbers with Rash	69	63	77	39	28	11	259
Do. without Rash	56	58	61	40	17	17	232

---

[1] The intravenous numbers are included also in the severe and the very severe. The other diseases are not included in the first table, as most received very small doses of serum.

TABLE V.—Table showing the Incubation Period of Serum Rashes following the injection of Serum in Diphtheria and Plague.

	DIPHTHERIA.			
Day of Appearance.	Total Rashes.	Urticarial Alone.	Intra Venous Injection.	PLAGUE.
3	1	1	...	...
4	6	3	2	1
5	11	8	2	3
6	14	6	3	1
7	26	21	4	6
8	35	28	4	6
9	57	45	7	1
10	41	36	2	2
11	18	14	...	1
12	8	6	...	...
13	15	11	2	...
14	5	5	2	...
15	9	3	...	...
16	6	3	...	...
17	3	1	...	...
18	1	...	...	...
19	2	2	..	...
20	...	...	..	...
21	...	...	...	...
22	1	...	..	...
Total of	259	193	28	21
Mean Day Appearance.	9·50	9·50	8·32	7·38

doses of serum have been given the first has been chosen as the date from which to calculate. This table shows that the commonest day for the rash to appear is the ninth after inoculation.

Serum has been given in two ways; in the great majority of the cases subcutaneously, but in a smaller number of cases, twenty-eight in all, directly into a vein. The general behaviour of the succeeding phenomena is so much the same as to make it unnecessary to discuss them separately, except to state that the mean date of appearance is 1.2 days earlier than that when the administration was subcutaneous. Whether the rash appears definitely, as has been seen in the case of the specific fevers, with an incubation period appropriate to each separate specimen of serum obtained from each different horse, cannot be ascertained from the records of the hospital, as the different consignments have not been noted separately, but it is possible that the same phenomena holds here as well. The serum used for the protection of the persons who had been exposed to the infection of plague is prepared, like that of diphtheria, by immunizing horses, and produced exactly similar symptoms. In this case it all consisted of one consignment. The figures are tabulated for comparison, and it is seen that of twenty-one cases in which the rash followed the injection of the serum the mean day of occurrence was 7.4 days, or fully two days earlier than the mean of the days of appearance of the serum rash in diphtheria; while the total range of variation of date was only seven days, as against twenty in the latter case. Were the serum of each horse collected separately it is probable that it would be found that the range of appearance of the subsequent rash were even more definitely limited.[1]

The data for determining the relation between the severity of the rash and the incubation period are, in the case of serum sickness, very numerous, but unfortunately there are special difficulties in the application. These arise because the intoxication produced by the serum is unfortunately apparently not due to a single poisonous substance but to a complex of poisonous substances, each of which produces a class of symptoms proper to itself. The most common rashes are the urticarial and the morbilliform. The two are frequently seen in the same patient, with a few days' interval between them, the urticarial in general occurring first. Some other forms, such as that of erythema circinatum with fever, are comparatively rare, nearly always occur late, and are definite clinical entities. In addition, true relapses of the rashes seem sometimes to occur, and are difficult to explain on any theory. One such occurred recently, when the patient suffered from an urticarial rash at the usual interval after inoculation, and again, after the space of six weeks, had a return of the same eruption, although personally she had not so far as she knew ever had an attack of urticaria before.

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[1] Since the above was written an example has been noted. Twenty-one children received on the same day a protective inoculation of antidiphtheritic serum all from the same consignment. Of these five developed no rash. In seven the rash appeared on the seventh day after inoculation, in four on the eighth day, in three on the ninth, and in two on the tenth day, showing a small range of distribution of the dates of appearance of rash, and indicating that here also the incubation period depended more on the injected material than on the patient treated.

The duration of the rash has been taken out in two ways; first, the total duration of all forms of rash, with the day of first appearance; and, secondly, the same facts for the urticarial form alone. A reference to the table (Table VI.) will show that in the former case the mean duration of the rash where the

TABLE VI.—Table showing the number of cases with each length of Incubation Period and the duration of rash.

Duration of Rashes in Days.	ALL CASES. Incubation Period.			URTICARIAL RASHES ALONE. Incubation Period.		
	3-7 Days.	8-10 Days.	11 Days and upwards.	3-7 Days.	8-10 Days.	11 Days and upwards.
1	7	9	8	8	13	10
2	12	46	24	9	33	14
3	18	37	21	11	32	12
4	9	26	9	7	19	...
5	4	7	3	1	8	7
6	3	3	4	1	2	1
7	1	2	1	1	...	1
8	2	1	...	1	1	...
9	...	...	...	...	...	...
10	...	1	...	...	1	...
11	1	...	...	...	...	...
12	...	...	...	...	...	...
13	...	...	...	...	...	...
14	...	1	...	...	...	...
15	...	...	...	...	...	...
16	...	...	...	...	...	...
17	1	...	...	...	...	...
18	...	...	...	...	...	...
19	...	...	...	...	...	...
Mean duration of Rash.	3·64	3·12	2·9	2·9	2·9	2·7

incubation period was under seven days was 3.64 days, where the incubation period was 7-9 days 3.12, and above that 2.9; but if the urticarias alone be considered the corresponding figures are 2.9, 2.9, and 2.7. The former figures show some difference, but the latter very little, and in the light of the complexity found in illnesses due to serum, and of the fact that the long-continued morbilliform rash is one with a shorter range of incubative period, it cannot be said that there is any very definite evidence that a short incubation period is associated with a severe disease.

We now come to the consideration of the facts relating to the crisis in disease. Apparently a period arrives when the attacked organism is able to manufacture anti-bodies in sufficient amount to neutralise the poisons of the disease quickly and effectively. In the diseases in which this phenomenon appears it occurs without any essential difference, except that its duration varies a little; it is shortest in relapsing fever, rather longer in pneumonia, and may extend to as much as three days in typhus fever; but in all it is associated with moistening of the tongue and sweating, clearing of the brain, and increased urinary discharge. It is to be noted in the first place that, as seen in the adjoining table (Table VII.), the distribution of the dates of recovery has marked similarity to those of incubation, whether diseases ending by crisis or lysis are chosen.

The significance of the date of recovery in interpreting the phenomenon of immunity is very considerable. It provides a means of comparing the method in which anti-bodies are produced in persons of different susceptibility and of different ages, and of gaining some information as to the reasons why decreased resistance may be associated with decreased susceptibility to the disease. It will be found by an examination of the tables presented,—compiled by different observers,—that from youth to age in the diseases which end with crisis there is a constant mean date at which the crisis occurs for all age-periods. It is found that the variation of this mean date in any group of statistics is always within three times the probable error, and consequently of no significance; that, in fact, at all age periods—no matter what alteration of the tissues may have been produced—there is, if recovery takes place, the same reaction at the same time. Further, the mean date at which death occurs is likewise almost constant. The change which takes place from youth to age in the tissues which renders persons of higher age more easy victims to zymotic disease is, therefore, a greater inability to produce certain bodies at certain times, rather than a want of resistive power in the tissues themselves. It may be seen from the tables this holds for typhus fever, pneumonia, and relapsing fever. The figures given for typhus are those of Dr. Russell. The figures for relapsing fever are those given by Dr. Tennent, while those of lobar pneumonia are based on the records of Belvidere for the last six years; they show essentially the same features (Tables VIII. A, B, C).

Table VII.—Table showing the dates of ending of various acute diseases.

	Numbers having crisis on each day from Onset.					Number of Cases of Measles on each day at which the temperature is first			Number of cases of Small-pox having first bath on each day after Onset.‡	
Day of Crisis.	Typhus.*	Typhus.†	Relapsing Fever.*	Pneumonia.	Day of Illness.	101° F.	100° F.	99° F.	Days.	Cases.
1	...	...	...	...	1	...	...	...	4-5	2
2	...	...	...	...	2	...	...	...	6-7	13
3	...	...	1	...	3	3	...	...	8-9	40
4	...	...	9	...	4	5	5	3	10-11	131
5	...	...	20	2	5	9	8	2	12-13	192
6	...	...	46	8	6	18	12	8	14-15	152
7	1	1	14	3	7	13	18	10	16-17	99
8	2	...	7	10	8	2	5	14	18-19	73
9	8	8	3	3	9	5	3	7	20-21	40
10	27	29	...	3	10	2	5	5	22-23	24
11	31	45	...	4	11	...	1	4	24-25	13
12	65	65	...	2	12	1	...	1	26-27	17
13	123	71	...	3	13	...	...	1	28-29	10
14	119	66	...	3	14	...	1	1	30 31	6
15	77	24	...	3	15	...	...	...	32-33	4
16	29	4	...	2	16	...	...	2	34-35	6
17	11	1	...	3	...	...	...	...	36-37	2
18	4	...	...	1	...	...	...	...	38-39	1
19	3	...	...	1	...	...	..	...	40 41	...
20	...	1	...	...	...	...	...	...	42-43	1
21	...	...	...	...	...	...	...	...	..	...
22	...	...	...	...	...	...	...	...	...	...
Total	500	315	100	51	...	50	50	50	...	826

* Murchison's Continued Fevers, p 187, 374. † Glasgow *Medical Journal*, Dr. Russell, 1871.
‡ Karl Pearson, Biometrika, Vol. iv. p. 508.

TABLE VIII. A.—CASES OF TYPHUS FEVER.

DR. RUSSELL'S CASES.*

Age Period, Crisis, and Death.

Day of Crisis or Death.	0-14		15-19		20-30		30-40		40-50		50—	
	Recov.	Death.	R	D	R	D	R	D	R	D	R	D
7	...	..	...	...	...	...	...	...	...	1	...	1
8	...	...	...	...	...	...	...	1	...	...	...	2
9	3	...	2	...	2	...	..	2	...	1	1	3
10	3	1	7	1	7	...	7	2	4	5	1	3
11	3	...	16	2	11	6	3	2	11	1	1	1
12	7	1	12	...	23	1	15	2	4	5	4	2
13	7	...	23	2	19	—	13	1	6	2	3	2
14	2	...	11	1	21	...	17	5	7	2	8	4
15	5	...	7	2	7	4	2	3	3	4	...	1
16	...	...	...	2	2	4	...	2	1	2	1	...
17	...	...	1	1	...	2	...	1	...	1	...	...
18	...	...	...	1	...	2	...	3	...	1	...	2
19	...	...	...	..	...	...	...	...	...	1	...	...
20	...	...	...	...	...	1	...	...	1	...	...	...
21	...	...	...	1	...	1	...	1	...	2	...	...
21-	...	...	...	2	..	5	...	—	...	1	...	1
Total - -	30	2	79	15	92	26	57	25	37	29	19	22
Mean Day Recoveries	12·2	..	12·4	...	12·6	...	12·6	...	12·5	...	12·9	...
Deaths . .	...	11	...	15·6	...	16·2	...	13·7	...	13·8	...	12·2
Mean Day of Death of those under 20 days	...	11	...	14·1	...	14·3	...	13·5	...	13·0	...	11·8

* *Glasgow Med. Journal*, 1871.

TABLE VIII. B.—Table showing the duration of the Pyrexial Period in cases of Relapsing Fever.*

Age.	No. of Males.	Mean Duration of Attack in Days.	No of Females.	Mean Duration of Attack in Days.
0-9	16	6·28	23	6·20
10 19	63	7 00	69	6·49
20-29	32	6·70	38	6 58
30-39	19	6·66	29	7·52
40-49	19	7·03	20	7·00
50-59	7	7·50	7	7·00
60-	6	7·16	4	7·00

* Tennent, *Glasgow Med. Journ.*, 1871, p. 385.

The character of the attack may, however, be measured in other ways, and the relation of the character of the attack to the capacity for acquiring immunity further investigated. One measure suggested at once is the date on which patients suffering from a fever are first stimulated. Dr. Russell's statistics are here of great value. The capacity for acquiring immunity steadily diminishes with age,

TABLE VIII. C.—CASES OF PNEUMONIA TREATED IN BELVIDERE FEVER HOSPITAL, 1901-1906.

Age Periods.

Day of Crisis or Death.	0-10		10-20		20-40		40-	
	R	D	R	D	R	D	R	D
5	1	..	...	...	1	...	...	...
6	4	...	2	...	1	1	1	...
7	...	...	2	...	1	1	...	1
8	3	1	2	...	1	..	...	...
9	...	...	5	...	2	...	3	1
10	1	...	...	1	2	...	...	1
11	...	...	1	1	2	...	...	1
12	...	...	1	1	3	2	...	1
13	..	...	2	...	...	...	...	...
14	1	1	2	...	...	...	...	...
15	...	...	3	...	...	...	...	...
16	...	...	2	...	1	1	...	...
17	2	.	...	..	...	...	..	...
18	...	...	...	1	...	..	2	...
19	...	1	...	...	1	1	...	..
20	1	...	...	...	...	1	..	...
21	...	...	1	...	...	...	...	...
22	...	..	...	...	...	...	...	...
23	...	...	...	..	...	...	...	...
24	...	..	...	...	...	...	1	...
Total . .	13	3	23	4	15	7	7	5
Mean Recoveries	10·0	...	11·3	..	10·4	...	13·3	...
. .			20	0-20	upw	ards		
Mean day of death	..	13·1	...	...	...	11·7	...	...

and yet, as will be seen by a reference to Table VIII. D, the date at which stimulant was found to be necessary is singularly constant, showing again that it is not lack of tissue resistance in old persons but lack of some other capacity which determines the issue of the disease.

Again the mean temperature of an attack of disease may be taken as a measure of its severity. A table (Table VIII. E) showing the figures for pneumonia has been constructed according as the mean temperature during the attack was below or above 103 F. The numbers are not very large, and though there is some slight difference shown in the dates of crisis and death it is not beyond what might be expected considering the number of cases. There is thus little difference shown in the results whether severity is measured by date of crisis, necessity of stimulant, or height of the fever.

TABLE VIII. D.—CASES OF TYPHUS FEVER.

Age Period. Day on which first stimulated.

Day on which first stimulated.	0-14		15-19		20-30		30-40		40-50		50—	
	Recov.	Death.	R	D	R	D	R	D	R	D	R	D
5	2	...	1	1	...	...	...	...	1	..	...	1
6	2	...	...	...	...	...	3	1	1	2	1	4
7	3	...	6	2	8	1	4	4	2	2	1	2
8	7	...	17	3	7	6	10	5	3	7	4	4
9	8	...	18	4	19	5	11	4	9	5	4	4
10	4	2	14	2	21	7	13	4	9	6	5	4
11	6	...	7	1	16	1	8	3	1	2	3	1
12	2	...	5	1	9	4	10	2	1	2	...	1
13	6	...	2	1	3	...	3	...	5	...	2	...
14	3	...	4	...	3	...	...	1	1	2	...	...
15	1	...	2	...	...	...	1	...	1	...	...	...
16	...	...	...	...	1	...	...	1	1	...	...	1
17	...	...	1	...	1	1.	...	...	...	...	...	...
18	...	...	...	...	...	...	...	...	...	...	...	...
19	...	...	...	...	..	...	...	...	...	...	...	...
20	...	...		...	...	...	...	...	...	...	...	...
21	...	...	1	...	...	1	...	...	...	1	...	...
Total - -	44	2	78	15	88	26	63	25	35	29	20	22
Mean Day of Stimulation	9·9	...	9·8	...	10·2	...	9·8	...	10·1	...	11·8	...
Recoveries .	9·9	...	19·8	...	10·2	...	9·8	...	10·1	...	11·8	...
Deaths - -	...	10·0		9·0	...	10·3	...	9·5	...	9·8	...	9·5

It is more difficult to obtain figures for other diseases which end by lysis. However, some figures were recently taken out with regard to smallpox for a different purpose. The date of the first bath was chosen as representing the end of the disease, and the cases showing an abundant or confluent eruption selected for comparison. A complication arises here as the presence of boils frequently delays the baths, and the larger the surface involved in the smallpox eruption the greater the likelihood of this secondary infection. A series of means has therefore been calculated representing the duration of the illness in all cases ending up to each definite date, and it will be seen that again there is a singular constancy in these means whether the cases be mild or severe, with the exception that there is a greater tail of septic cases among those with a confluent as compared with those with an abundant eruption.

TABLE VIII. E.—CASES OF PNEUMONIA TREATED IN BELVIDERE HOSPITAL, 1901-1906.

Average Temperature.

Day of Crisis or Death.	<103°F.		>103° F	
5	...	...	2	...
6	2	1	6	...
7	1	2	1	...
8	1	...	3	1
9	7	...	3	1
10	1	..	2	2
11	2	1	1	1
12	2	3	2	1
13	1	...	1	...
14	1	...	2	1
15	3	...	...	...
16	3	1	...	...
17	1	...	1	...
18	1	...	1	1
19	1	2	...	...
20	...	...	1	1
21	...	...	1	...
22	...	...	...	...
23	...	...	..	...
24	1	...	...	...
Total . . .	28	10	27	9
Mean, Recoveries .	12·3	...	10·2	...
Mean, Deaths .	—	12·1	...	12·4

The general conclusions which are to be drawn from this series of facts is that for any given disease there is little difference in the method by which immunity is produced, or in the period at which the curative properties of the body come into action, even although the ability of the organism to produce the necessary anti-bodies varies immensely. Thus, between the ages of 15 and

20 the mortality from typhus fever is in Dr Russell's cases (Table VIII.A) about 16 per cent., and in those above 50 years of age over 50 per cent., yet the mean date of crisis is identical, a phenomenon only to be explained on some such basis as this. Nor does the poison of the fever apparently act in a more virulent fashion on older than on younger persons in the sense of producing symptoms of cardiac failure earlier or later. The date on which stimulation was found to be necessary (Table VIII. D) is practically constant from youth to age among those patients who required it, nor is there much evidence that the symptoms of profound poisoning developed much earlier in fatal cases than in the recoveries, the fatal issue being in general apparently due to an inability to produce the necessary protecting substances on the part of the patient rather than to any special virulence of the

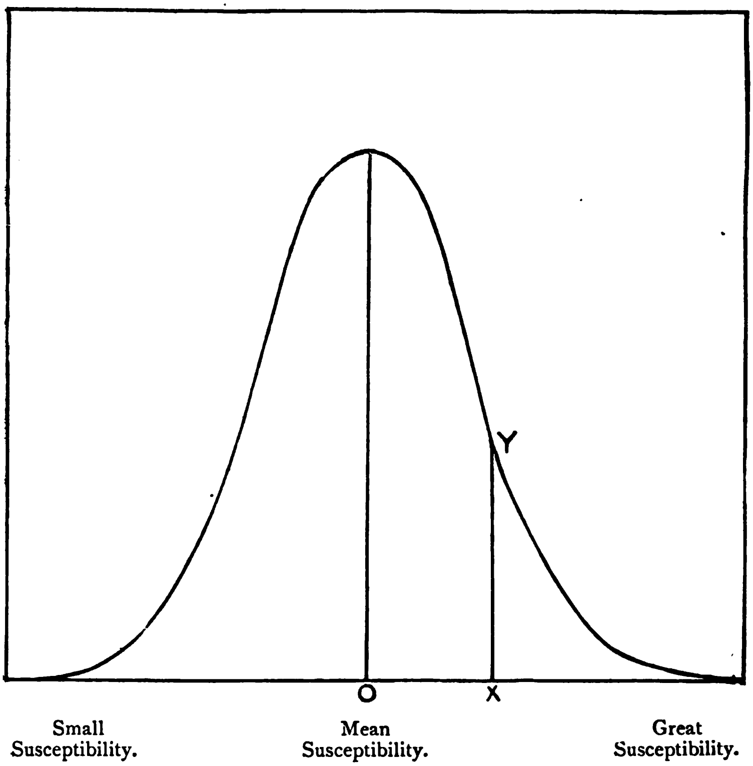
TABLE IX.—Table showing Number of cases of Smallpox in Vaccinated Persons having the first bath on each day after onset of disease, with the corresponding Means.

Day of First Bath.	Eruption. Abundant.	Eruption. Confluent.	Mean Duration of all Cases up to the respective day. Abundant.	Mean Duration of all Cases up to the respective day. Confluent.
4	1	1	...	...
5	2	...	...	...
6	...	...	...	...
7	7	1	...	..
8	15	5	...	...
9	18	10	...	...
10	24	9	...	...
11	24	8	...	...
12	27	14	9·8	10·1
13	22	5	...	...
14	20	8	10·8	10·9
15	12	7	...	...
16	6	10	11·4	11·9
17	8	6	...	..
18	3	4	11·8	12·7
19	3	2	...	...
20-25	11	9	...	...
25-30	4	8	..	..
30 40	2	4	...	..
40-50	...	Total,	13·3	15·3
50-60	...	...	...	...

organism infecting those cases which end in death. In support of this it is to be noted that the mean day of death (Table VIII. A) is higher than the mean day of crisis, and even when those cases who died after 20 days of illness are excluded on the ground that some complication probably caused the fatal issue this is yet more marked, another proof that the fatal issue is due to the cause stated and not to less resistance of the tissues. The same facts are also true for pneumonia (Table VIII. C). For typhus fever there is some evidence that among those from 15-30 years of age death takes place at a slightly later period than among those older, and in this case the greater resistance of the tissues in younger persons may easily be the cause of a more protracted struggle against the toxines of the infecting organism, a fight however, useless on account of the inability of the patient to produce the necessary protecting substances.

It has been seen that the incubation period varies continuously from a short to a long one, having a maximum in between with the distribution on either side of this maximum in many cases not far from symmetrical. In the same way the length of a disease where it can be easily measured has been seen to fulfil the same conditions. This measurement is most easily made in the case of disease ending by crisis, but as has been seen in the table is equally true of such diseases as measles and smallpox. It affords one means of measuring the severity of an attack.

The general severity of typhus fever has been measured in two ways in the case of Dr Russell's statistics—one, the date of the crisis, the other the date on which the stimulation was begun. As has been seen the distribution as regards severity afforded by these two methods is essentially the same. There is a mean severity on either side of which the cases tend to group themselves, and the same is true with regard to the deaths. This is an important point as showing the independence of natural immunity and the capacity for acquiring immunity, and it is a general phenomenon throughout disease. It was this fact which made it clear to me first that the processes of natural immunity must be largely different from those displayed in acquiring immunity. An example of this based on some figures given by me was published by Prof. Pearson in *Biometrika*, Vol. IV. p. 508, in a paper criticising another paper in the same number by Dr T. M. Turner in which the opinion was expressed that the mildest cases of the disease should be the most common. If natural immunity depended on the same range of factors as the acquirement of immunity then as of the whole population attacked by an epidemic the great majority escape, it follows that the number of mild cases should be in excess of the number of severer, that is to say there should be a continual increase in number of those infected by the fever as the cases are graded from severe to mild. A reference to the diagram will illustrate this point.



In this diagram the whole population is grouped according to its susceptibility in the general form which such distributions are observed to take, namely, that a mean susceptibility is commonest and that higher and lower susceptibilities become less and less frequent the further they depart from the mean. At the one end of the curve the ordinates represent the number of very susceptible persons, at the other of very insusceptible. If susceptibility be the criterion for infection it follows that an ordinate in some such position as XY will represent the dividing line between those attacked and those escaping, the position of the ordinate on the susceptible side of the mean being determined by the fact that the great majority of the general population escape infection. The ordinates of the part to the right of XY then represent the numbers of persons with different degrees of severity, if susceptibility has any necessary direct relation to severity of attack, *i.e.*, the ordinate XY representing the ultimate limit of susceptibility which permits infection will represent the number of mild attacks. This, it is obvious, is completely at variance with what has been found earlier in this paper (Table VII.) to be the universal rule, namely, that there is a mean severity of attack on either side of which milder or severer tend to group themselves. This seems to prove that natural immunity and the capacity for acquiring immunity, or in other words the susceptibility to disease and the tendency to severity must depend at least very considerably on different mechanisms.

NOTE.—All the data here considered refers to diseases acquired by the ordinary processes of nature, and not by artificial methods such as inoculation in the laboratory.

The Report of the Select Committee of the House of Commons, on the Land Values Taxation (Scotland) Bill, 1906. By JOHN A. TODD, B.L., Solicitor, Glasgow, Lecturer on Political Economy.

[Read before the Economic Science Section, 14th January, 1907.]

THIS Bill, now known as the "Glasgow Bill," was first introduced in the House of Commons in the Session of 1898. From that time till its final reintroduction in 1906, it has reappeared in every Session of Parliament, and has met with gradually increasing support. On 23rd March, 1906, it was read a second time in the House of Commons by a majority of 258 in a House of 380. On 24th April, 1906, a Select Committee of the House was appointed, which sat for nineteen days taking evidence. Thirty-four witnesses were examined by the Committee, and evidence in the form of Memoranda was given in by other twenty-two gentlemen who were not called. The Report of the Committee was issued on 13th December, 1906, and a summary of its contents is embodied in the appendix.

It is satisfactory to find that the Committee are agreed in condemning the Glasgow Bill, for after narrating its provisions, the Report says:—"Your Committee consider these proposals to be indefensible. No evidence was adduced in support of them. No one justified the choice of 10 per cent. It was apparently arrived at by haphazard, without any calculation or estimate of what its effects would be. The objections entertained by your Committee to the proposals of the Bill were such as to compel them to come to the conclusion that it ought not to be proceeded with in its present form." [1]

The Committee go on, however, to express their approval of the principle which, they say, underlies legislation of the class to which this Bill belongs, thus:—"The main principle which, in the opinion of your Committee underlies proposals to tax land values is the setting up of a standard of rating whereby the ratepayer's contribution to the rates is determined by the yearly value of the land which he owns or occupies apart from the buildings or improvements upon it, the object being to measure the ratepayers' contributions, not by the value of the improvements on the land to any extent, but solely by the yearly value of the land itself."[1]

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[1] Report, p. 6.

In the first place, it is to be inferred from the terms of the Report that it is not proposed to apply the new standard to anything but local rating, and the Solicitor-General for Scotland has since emphasised this point in a public speech.[2] The question will therefore require to be known in the future as the "rating," not the "taxation," of land values. In passing, one might ask why this should be so. Every argument in support of the adoption of the new standard for local rating seems to apply equally to the case of Imperial taxation. It would seem absurd that the whole of the present system of valuation should be maintained alongside of the new system merely for the sake of Property Tax and Inhabited House Duty,—the only Imperial taxes that are assessed on rental.

It is apparently intended[3] that not only owners' rates but also occupiers' rates are to be assessed on the new standard of land value, and again that the new rule is not to be confined to Burghs, as provided in the Glasgow Bill, but is to be extended to the whole country.[4] It will be found that these points materially increase the practical difficulties of the proposal.

The first question that arises is as to the essential meaning of this proposal—upon what principle or canon of taxation is it based? For purposes of comparison we may first ask the same question as to the present system.

The system of local rating based on rental is somewhat difficult to bring into line with any one accepted principle of taxation. It may, however, be stated that so far as regards such services as the care of the poor, public health, and education, which Sir Robert Giffen calls "onerous" rates, the allocation of the burden in proportion to rental is supposed to be an approximation to the recognised rule of equality of sacrifice. On the other hand, such services as water, lighting, cleaning, and drainage, and more generally what are known as "beneficial" rates, because they tend directly or indirectly to increase the value of property, are assessed upon rental because that is supposed to be as nearly as possible a measure of the benefits received. The tendency of recent years has been to lay increased emphasis on benefit received as the basis of taxation, and to approve of or condemn particular proposals because they seem to comply with that idea or otherwise. The question is then which of these rules, if either, underlies the proposal that all local rates should be based on land value.

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[1] Report, p. 6.

[2] At Broxburn on 28th December, 1906.

[3] Report, p. 6, second passage above quoted—"lands which he owns or occupies"; and p. 14, conclusion—"that so far as both occupiers and owners are concerned the new standard of rating should be substituted for the present standard."

[4] Report, Recommendation II., see Appendix.

It can hardly be claimed in the case of ground already occupied by buildings that land value is a better test of capacity to pay, than rental. Take, for example, the illustration so frequently brought before the Committee of the comparative rentals and land values of the Ocean Chambers in West George Street, and the property of Messrs. Keydens & Co. adjoining.[1]

Messrs. Keydens' property is one of the original dwelling-houses in West George Street, converted into an office which they occupy themselves. It is entered in the Valuation Roll at a rent of £275 per annum. In 1899 the Ocean Company bought two similar houses adjoining at a price of £15,750. They cleared the ground and erected upon the site a seven storey block of offices yielding a rental of £2002, nearly eight times that of the adjoining block. The land value on the basis of the Glasgow Bill would presumably be four per cent. on the price paid, or £630 in all, while that of Messrs. Keydens' property, which contains, roughly, half the area, would be £315.

It seems fairly obvious that, from the point of view of equality of sacrifice, the rentals of these two properties should supply a better test of the relative capacity of the owners to bear taxation than the figures placed upon their land value. A man who is drawing a rental of £2000 ought to be able to pay eight times as much as his neighbour who draws only £275. To argue otherwise would imply that the amount of income received is no test of capacity to pay, an argument which of course goes to the root of our whole system of taxation.

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[1] I should apologise for mentioning names, but as this particular instance has been bandied about daily in the Committee I may be excused for continuing it—it saves time.

The same point is emphasised when we consider the position of the respective occupiers of these two buildings. Can it be argued that the whole of the occupiers of the twenty-one offices, large and small, comprised in the Ocean Chambers, can only contribute among them to local rating twice as much as the single firm of Messrs. Keydens?

Taking next the idea of benefit received, it will probably be admitted that from at least the majority of the many municipal activities of Glasgow the proprietors of the Ocean Chambers, and still more their tenants, derive far greater benefit than the owner and occupier of the small property adjoining, and that the allocation of the benefit (and the burden) according to rental is more likely to meet the justice of the case than according to land value.

Recalling the fact that the proposed new standard of rating is to apply to the country as well as to the town, let us apply the same tests to the case of a suburban villa. In a semi-suburban village the highest feuing rate will as a rule be found near the railway station or on the most important thoroughfare, where, as the village grows, shops are rapidly replacing the earliest houses, thus increasing the land value. The occupant of an old-fashioned house in such a situation can hardly be regarded as better able to pay taxation than his wealthy neighbour who prefers a more retired situation. It is conceivable that the owner of the former house may expect to benefit some day by the increased value of his site; but why should his tenant pay higher taxes in the meantime? Or again, is a man's capacity to bear taxation to be judged by the size of his garden and the consequent amount of his land value, rather than by the size and rental of his house? Surely the latter is the better test not only of this, but also of the benefit he is likely to receive from communal expenditure.

It seems apparent, therefore, that the idea of taking land values as the standard of rating cannot be based on any recognised canon of taxation, and we naturally turn to the Report for a hint of the underlying idea. This is what we find,[1]—"The justification given for the adoption of the new standard is that land owes the creation and maintenance of its value to the presence, enterprise, and expenditure of the surrounding community. The value of the land is not created or maintained by the expenditure or exertion of its owner, except in so far as he is a member of the community. It is well, therefore," (note the causal connection) "to select a standard of rating which will not have the effect of placing a burden upon industry. Hence the proposal to exclude from the standard the value of buildings and erections of all kinds, and fixed machinery. To include these in the standard tends to discourage industry and enterprise. To exclude them has the opposite effect. If, then, the value of bare land apart from improvements be chosen as the measure by which to fix contributions to local expenditure, the ratepayer will, it is alleged, be merely restoring to the exchequer of the local authority part of that which he has derived from it."

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[1] Report, p. 6.

There seem to be here two entirely distinct ideas:—(First) that land is a form of property peculiarly appropriate for special taxation, and (second) that industry in the form of capital expended on heritable property should be exempt from rating.

With the first of these arguments we are already familiar. It is the old idea of unearned increment and the Single Tax. I have already in a previous paper[1] stated my views on this argument, and it is not necessary to discuss it again.

Nor will the second argument bear closer examination. On the face of it, it means that capital expended on heritable property should be exempted from taxation. Is it seriously maintained that those who invest their capital in buildings require this, because clearly it would not be the building industry, but only the owners of buildings that would benefit directly by the exemption of the value of the buildings from taxation? The tendency would presumably be to promote the erection of new buildings; indeed, that is openly avowed in the Report[2] as one of the objects of the proposal, but if one may judge by the present condition of the property market in Glasgow, the benefit to the proprietors at least would not last long. It is evident that the erection of large office and warehouse blocks has already been carried too far. Warehouses and offices are standing empty in every street in town, where a few years ago a "To Let" board between terms was a thing almost unknown. The same state of affairs will be found with regard to dwelling-houses in every part of the city. Anything that would tend to accentuate the present state of matters by tempting further building in Glasgow just now would be an unmitigated evil, except perhaps to the tenants, who might expect for a time to get premises at rents which would certainly not be remunerative to the present owners. We know, however, that in economics that kind of thing ultimately remedies itself.

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[1] Proceedings, Vol. xxx. p. 140, 22nd March, 1899.

[2] Report, p. 6.—"The indirect effect of the adoption of the new standard will be to stimulate buildings and improvements, to bring more building land into the market, to lower rents, and to diminish overcrowding."

The real meaning of this paragraph of the Report will be found in another direction altogether. If the separate assessment of land values is to be made the first step towards the shifting of the burden of local rating from the shoulders of the occupiers to those of the land owner, that would indeed be a relief to industry worth fighting for. Taking it in this sense, the Report becomes at least coherent. It explains the curious blending of the two ideas already referred to, as alternately cause and effect. Let me paraphrase the argument thus:—*Because* land owes its value to the presence and expenditure of the community, *therefore* it is well to select a standard of rating which will relieve the products of industry (by throwing more of the burden upon the value of land). *Thus* we shall compel the ratepayer to restore to the exchequer of the local authority part of that value which he has derived from it. Stated in this way, the real meaning of the argument becomes clear. It is that, as nearly as possible, land should bear all the taxes, and industry none. But this is simply the Single Tax over again.

Before leaving this part of the subject, let me point out that even in a properly considered scheme for the taxation of land values there is a very serious assumption—viz., that the effect of the presence and expenditure of the community is to increase the value of the *land*, not of the *property*. Is this correct? Is it right to say that any expenditure of the community, *e.g.*, the provision of a new park, results in benefiting not the property of the adjoining proprietors, but the value of their land alone? What is the measure of the benefit derived from such an improvement? Is it not the increased rental to be drawn from the property? Surely this at least is the proper test as regards the tenants to whom the benefit derived is directly measured by their increased rental.

The increased rental is, of course, reflected in the increased capital value of the land, and here we are met by another argument. What if one proprietor does not choose to take advantage of the increased rental he might now get by knocking down the old dwelling-house on his site and erecting tenements? Here is a possible advantage of the proposal to rate on land value instead of on rental. It may "get at" the man who does not make the most profitable use of his site. This implies that the valuation of the land is to be made, not according to its actual present use, but according to some potential or hypothetical "best use." One looks naturally to the Report to find whether that is the intention of the Committee, but in vain. There was wide divergence of opinion on this point among the witnesses, even among those in favour of the scheme, and the Report leaves it severely alone.[1]

Passing now to some objections on points of practical detail the first is naturally the question of valuation. It is unnecessary to go again into the difficulties of making a separate valuation of land.[2] Such a valuation is of course not impossible, yet one cannot but admire the prudence of the recommendation that no assessment based upon the new standard should be determined upon until the new valuation has first been ascertained and considered.

I would like, however, to point out one or two difficulties that have been raised by the new form of the proposal as recommended by the Committee, particularly in respect of the proposed application of the new standard to occupiers' assessments and to country districts. For example, the Glasgow Bill provided that the land value was to be settled between the proprietor and the assessor. Are the tenants (there may be fifty of them on one site) to be bound by the valuation thus fixed, or are they to have a say in the fixing of it? If the latter, how are they to obtain information as to the extent of ground and the nature of the proprietor's title, and as to any restrictions which are in the words of the Report "validly imposed upon the land?"

It will be remembered that one of the worst complaints against the present system is that agricultural land in the suburbs which is being held up for feuing is assessed only on its agricultural rental, which is merely nominal compared with its real feuing value. This, presumably, will be amended under the new system. Is the farmer who occupies the land to pay rates on the enhanced value?

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[1] Unless one may argue from such a passage as this (Report, p. 6)—"Owners of valuable land, either unoccupied or occupied by buildings unsuitable to the site, will pay more; owners of highly utilized land will pay less"—that the "best use" standard is what is really intended.

[2] See previous paper.

Again, the total proportion of occupiers' rates payable from such a building as the Ocean Chambers will, under the new scheme, be assessed on the land value of the whole block, but how is this to be divided among the twenty-one tenants of the various offices? There is no equitable way except in proportion to the rental. It will therefore be necessary to retain the present system of returns of rental for this purpose.

The measure of value is to be the bare value of land apart from any buildings or improvements upon it, and it is also stated that any exceptional expenditure made in preparing a site for building within, say, twenty years of the date of the valuation is to be allowed for. How is this criterion of "improvements" to be applied to agricultural land? The whole of the agricultural land in Scotland is "improved"—its value more or less due to drainage, fencing, manuring, tillage, etc. Is this to be allowed for, or only if it has been done within twenty years of the valuation—and will the valuation be altered every year as time runs out, and another portion of the original improvement falls out of the category of recent improvements? Is agricultural industry only to be encouraged for twenty years?

It is recommended that in making the Valuation, railways, canals, piers, docks, and harbours should be excluded, "but if this be doubtful, your Committee are of opinion that the special basis on which these undertakings are now valued for rating purposes ought not to be disturbed."[1] What will be the effect if the latter alternative is adopted? As will be shewn by figures, the result of adopting the new standard of rating will be to increase very greatly the rate per £ of the assessments. Is it intended that railways, etc., should pay the higher rate on the present valuation? Surely this is a strange alternative to total exemption.

Actual figures will be found most useful in bringing out the effect of the proposed new standard particularly in the redistribution of the burden of rating. For this purpose I have taken the municipal area and rating of Glasgow as typical of the extreme case of high land value, and with that the case of Parish and County rating in the adjacent Parish of Cadder, of which I have some knowledge. The results of these figures may be summarised as follows:—The total valuation of the Municipal area of Glasgow for 1905-1906 was £5,770,000 upon which (or rather upon a nett rental of about five millions) Municipal assessments are imposed amounting in all to—Owners, 1s. per £, and occupiers (above £10 rental), 2s. 9d. per £, in all, 3s. 9d. per £.

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[1] Report, p. 10.

The land value of Glasgow has been estimated at very different figures. Dr. Murray puts it at ten per cent., Mr. Peter Burt at sixty per cent. of the gross valuation. For the sake of argument we may take something between these two extremes, say two millions as a figure to work upon, though I believe that is high. The Report assumes that, in the meantime at least, the division of rates between owner and occupier is to remain as at present.[1] This means a rate of 2s. 8d. per £ of land value on owners, and of 6s. 11d. per £ on occupiers, or 9s. 7d. per £ in all, and that, remember, for municipal rates alone.

Let us apply these figures to the case of the Ocean Chambers and Messrs. Keydens' property. (See Statement I. in Appendix). The whole tenants of the Ocean Chambers are at present paying £275 of municipal rates. Under the new system they will only pay among them £218, a reduction of fully twenty per cent. Messrs. Keydens & Co., on the other hand, who are at present paying as occupiers £38, will now have to pay £151. The effect on the relative owners' rates as will be seen from the Statement is similar.

Take another illustration—a house in the West End entered in the Valuation Roll at £220. It is an old house, twice added to and improved, but it has comparatively little ground. The feu-duty of £17 probably represents the full value of the ground. The municipal assessments just now are, as owner, £11, and as occupier, £30 5s. Under the new scheme they will be as owner, £2 5s. 4d., and as occupier, £5 17s. 7d., or £8 2s. 11d. in all, against the old total of £41 5s., and as will be seen later on, the holder of the feu-duty will have to pay the £2 5s. 4d. of owner's rates.

Now take Cadder Parish. Here I have been able to itemise the present Valuation (see Statement II. in Appendix) and estimate the new land value for myself—not without difficulty. There is, for example, the difficulty of the valuation of agricultural land. I have taken it at about one-half, which is probably a fair guess. The difficulty of railways and canals, etc., I have also already referred to, but I have taken £2000 as the probable land value of the Stations.

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[1] Report, p. 6. "Owners *inter se* and occupiers *inter se* will pay in very different proportions, etc., etc.

But what of minerals? Their value presumably must be included, if at all, in the value of the surface; but I have made an allowance of £2000 to cover the value of land occupied at the pit-head, and by works, bings, brick fields, etc.

The other subjects consist mostly of dwelling-house property, and I have estimated the land value there at one-seventh, which is probably high. £5 of feu-duty for a house of £35 rental is over the average.

The result is a total land value of £18,000, as against the present gross valuation of £81,000. The nett valuation upon which assessments are at present levied varies considerably, for the deductions allowed in the case of Parish and County Rates and owners and occupiers respectively are complicated. These deductions are mainly supposed to cover the cost of upkeep of buildings, and will therefore not come into the new calculation.

On these figures the total Parish Rate, which is at present 1s. per £ on owners and 1s. 0½d. on occupiers, will become 3s. 11d. per £ on owners and 3s. 5d. per £ on occupiers, while the General County Rate, which is at present 9¼d. per £ on owners and 6¼d. per £ on occupiers, will become 3s. 5d. per £ on owners and 2s. per £ on occupiers. In the various Special Districts created for water, lighting, drainage, and scavenging purposes, the total rates are much higher, *e.g.*, in Bishopbriggs these special rates alone amount at present to 1s. 5¼d. per £ both on owners and occupiers, which will become 6s. 6d. per £ on each under the new system.

Let us apply this to two typical cases—a villa at Bishopbriggs and a farm outside any of the special districts.

(1) VILLA AT BISHOPBRIGGS.

PRESENT ASSESSMENTS. RENT SAY £35.

Owner, -	3/2½ per £,	-	£5 12 3	
Occupier, -	3/- „	-	5 5 0	
				£10 17 3

NEW ASSESSMENTS. LAND VALUE SAY £5.

Owner, -	13/10 per £,	-	£3 9 2	
Occupier, -	11/11 „	-	2 19 7	
				6 8 9
			Being a reduction of	£4 8 6

or fully 40 per cent.

(2) FARM OUTSIDE SPECIAL DISTRICTS.

PRESENT ASSESSMENTS. RENT SAY £200.			
Owner,	1/9¼ per £ on £200,	£17 14 2	
Occupier,	1/6¾ per £ on £75 (⅜ths of total valuation), -	5 17 2	
			£23 11 4
NEW ASSESSMENTS. LAND VALUE SAY £100.			
Owner, -	7/4 per £, -	£36 13 4	
Occupier, -	5/5 „ -	27 1 8	
			63 15 0
		An increase of	£40 3 8

or fully 170 per cent., and to the occupier an increase of £21 4s. 6d., or fully 360 per cent.

It is clear from these figures that an even greater reduction than the present five-eighths will require to be made in favour of the tenant farmers or agriculture will be ruined altogether. Of course any such reduction means a corresponding increase in the general rate.

These figures show that the rate of assessment per £ of the land value will be very heavy, and this rate so far as payable by the owner of the subjects will fall on him not as owner of the property, but merely as owner of the ground. The next point is,—what will be the result if the owner of the house and the owner of the ground are not the same person, *i.e.*, if, as is usually the case, the value of the ground is represented wholly or partly by a feu-duty payable to the superior?

The question of whether superiors or holders of existing feu-duties should contribute to the rates in respect of that proportion of the land value which is represented by the feu-duty has been, as the Report says,[1] the subject of the keenest controversy. The grounds upon which the Committee have rejected the claim for exemption of such feu-duties are (*first*) that the superior is not a mere creditor of the owner with a security over the land, but is really the owner of an interest in the land, and (*second*) that the feu-duty, which is the annual return from the vassal to the superior, is truly a rent for the land. With these contentions one may, for the sake of argument, be quite prepared to agree. They do not really affect the question. Let me explain my position on this point. I do not say that feu-duties as such should not be taxed. It might have been better in some ways if the present system under which the feuar pays all the owner's rates had never developed. But, taking things as they are, I do say most emphatically that to adopt the line proposed by this Report would be a violation of contract far more harmful in its effects than could possibly be compensated by any gain likely to result from the change.

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[1] Report, p. 10.

As this question of the position of existing feu-duties is of great importance, it is necessary to make a lengthy quotation from the Report, p. 11:—

"In the evidence given before your Committee it was, however, strenuously maintained that to compel those drawing feu-duties to make a contribution to rates in respect of the amount so drawn was to violate existing contracts. And although no witness was able to explain what, in the present connection, he meant by that phrase, your Committee understand that it was intended to convey that feuars had become expressly bound to pay all public burdens present and future which might be laid upon the lands. It would be contrary to this bargain, is the suggestion, to permit a feuar to pass part of his own burden on to the shoulders of the Superior. Now, it may or it may not be true that, by the Common Law of Scotland, the Superior is bound to bear his share of public burdens imposed on the feuar in the proportion which the feu-duty bears to the yearly value of the land and buildings. Your Committee offer no opinion upon this question. But this, at all events, is certain—that a clause by which the feuar binds himself to relieve the Superior of public burdens present and future is not of unlimited application. It is in law confined to burdens the same in nature and in incidence as those in existence at the date of the contract, and which are, therefore, held to have been in contemplation of the parties at the date of the Feu Contract. Such a clause affords no relief from burdens created for the first time by supervenient laws. Novelty sufficient to take a public burden out of a clause of relief may arise in either of two ways—'There may be a burden existing at the date of the contract, and subsequently the incidence of that burden may be so altered that, although the burden *in specie* remains the same, the same in name and the same in application, still a change subsequently made by law in the incidence of the burden may be such that it becomes, with reference to a contract of this kind, a new burden, and is no longer covered by the contract. Or, on the other hand, the incidence of the burden may remain the same, and yet the application of the burden may be so entirely different that the burden will become, although the same in name, yet a different burden *in specie*, and no longer be covered by the contract.' (Lord Chancellor Cairns in *Dunbar's Trs.*, 3 Ap. cases, 1305.) A burden, imposed by a supervening law, raised on a different subject, and on a different principle from any sanctioned by law at the date of the contract, falls outside the ordinary clause of relief. If, then, a new burden be imposed, or if the incidence of an existing burden be altered by laws enacted after the date of the obligation, the clause of relief is, in law, inoperative, so far as that burden is concerned. Now, an assessment on the basis of the yearly value of land, apart from buildings, and levied from the owners of land, including the owners of feu-duties, would, in the opinion of your Committee, be a new burden differing materially in its character and incidence from any existing burden on land, just as an assessment for the support of roads in a county levied on real rent is a burden different in character and incidence from an assessment to be devoted to the same purpose but levied on the valued rent. No contract now extant, so far as the evidence laid before your Committee goes, refers to such a burden or contemplates its imposition. Existing contracts would, therefore, be left untouched if the new standard of rating were applied in the case of owners of feu-duties created prior to the date when the enactment first takes effect. It is worthy of notice that in the Scotch Valuation Act provision is made for long leaseholders deducting from their rent the proportion of owner's rates applicable to the amount of the rent. If for 'lessee' feuar be read, for 'actual proprietor' superior, and for 'rent' feu-duty, then the law at present in force, as contained in the Sixth Clause of the Scotch Valuation Act, is almost identical with the provisions contained in Clause Seven of the Bill."

Much might be said on the legal arguments involved in this quotation, but I shall only refer to the case of *Dunbar's Trustees* upon which the argument is based. That case turned on a Feu-Contract under which the Superior had undertaken to free the vassal "of the whole cess or land tax, feu-duties, or other duties, ministers' stipends, schoolmasters' salaries, and other public burdens due and exigible out of the whole lands and subjects hereby feued or that may become due and payable for or from the same in all time coming." The superior claimed that this obligation of relief did not cover the Poor Rates and the assessments for the upkeep of roads and streets. In the case of the Poor Rate his claim was rejected because it was held that the object and incidence of the tax remained the same as formerly, and the change that had been made was merely an improvement in the mode of application of the burden and in the mode of administration of Poor Law Relief. But the Road Assessments were held to be in a different position. The roads were formerly kept up by a compulsory contribution of services from "all heritors in the natural possession of their own land, and all lessees and occupiers of land, and all householders and cottagers, and all labourers, and all tradesmen, carters and carriers, and other persons keeping horses for hire or labour." This was known as the Statute Labour, and it will be noted that the essence of the liability to contribute was occupation, and presumably use of the roads; but under certain private Acts it was converted into an ordinary assessment on the owners and occupiers of all property in the Burgh or County, according to the real rent, which is the modern Valuation Roll. This new assessment was held by the House of Lords to be a burden of a different description from the old Statute Labour, different in its incidence and wider in its objects. It was therefore held that it did not come under the Clause of Relief and the vassals had to pay it.[1]

The next question is whether the proposed rating on land values is a tax new in character and incidence in terms of that decision. Remember that by incidence here is meant only the direct or legal incidence, not the ultimate or indirect incidence which is always problematical. We are considering only the question "Upon whom has the legislature imposed the primary payment of these rates?" Beyond that, of course, is the much more difficult question, "Upon whom will the burden ultimately be laid by the higgling of the market?"

Now, a change of incidence in this sense of legal incidence means a change of the *person* who is legally liable to pay the rates. All taxes are imposed on *persons*, not on *things*. A *thing* may be apparently the "object" of taxation, but in reality that is only the means of getting at the "subject" or *person* behind it who is intended to pay the tax. How, then, does the proposed assessment on land value make existing rates new in incidence? Take the Poor and School Rates or any of the Municipal Assessments which are at present payable partly by the owner and partly by the occupier upon the basis of rental. The "object" of these rates is to be changed from property including land, to land alone, but the "subject" remains the same. The occupier and the owner of each property will still pay the rates in the same proportion as before, and the purposes to which the rates are to be applied are in no way affected. The mere change of the basis of assessment from rental to land value will not affect the contract between superior and vassal under which the latter has hitherto paid these rates. Nothing but an Act of Parliament will do that. There is, therefore, no change in the incidence of these rates unless the Act specifically makes such a change.

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[1] The argument of the Report assumes that the principle here laid down would apply equally to the converse case of a vassal claiming relief from the superior, but that is by no means certain. There must have been many such contracts in existence, but there is no recorded case of any such attempt by a vassal to escape from his obligation of relief.

Keeping this in mind, let me now state the argument of the Report as it appears to me. If a tax is new in character and incidence, then the ordinary Clause of Relief in a Feu Contract will not apply to it. We propose that Parliament should alter the incidence of all the present rates by making the superior pay them notwithstanding the contract. If that is done, then they will be new in character and incidence, and, following Dunbar's case, the superior will not be entitled to relief from them under his contract; and, of course, if the superior is not entitled under his contract to claim relief from these rates, there can be no injustice in our imposing them upon him by Act of Parliament.

Let me state it again in another form. The contract between superior and vassal is that the latter is to pay the rates. We propose to assess the same rates on a different basis,—land value instead of rental,—but that does not of itself affect their character or incidence. They will still by force of law and the terms of the contract be payable by the vassal. But if we break that contract and make the superior pay them, then by our doing so their incidence will be changed, and then by force of law the superior will be bound to pay them. Because by Act of Parliament we have forced him to pay them, therefore, in terms of his contract, he will not be entitled to relief, and this is put forward as an argument in favour of the moral right of Parliament to break the contract. Is this not arguing in a circle?

One more point,—the attempted analogy between feus and long leases under the Valuation Act of 1854. Surely the difference between these two is very plain. At the end of the Lease the land with its enhanced value goes back to the owner. The Feu Contract has no end.

Let me emphasise the importance of this question of the rating of existing feu-duties by figures showing what it involves. Take Bishopbriggs District again. (See Statement II.). The total owners' rates, including the Special District Rates for water, scavenging, drainage, and lighting, will be, as I showed, about 13s. 10d. per £. Now, in recent feus where the feu-duty represents the whole of the land value, the holder of the feu-duty will have to pay the whole of the owners' rates. Thus at one stroke he loses two-thirds of his income, and the owner escapes absolutely free of local rates. And this part of the Report was only carried by the casting vote of the Chairman,—the Solicitor-General for Scotland,—in breach of the express undertaking admittedly given in the House of Commons by the Lord Advocate that no such proposal would be entertained.

Were it possible that such a proposal should receive the consent of a British Parliament, what would be the result? First, it would mean the practical annihilation of the value of existing feu-duties, and second, the abolition of the feuing system. Is it conceivable that any sane man would feu his ground knowing that he could never by any possibility receive a penny more than the amount contracted for, but that on the contrary he was certain to lose the greater part of it at once, with every probability of the remainder following, as soon as Parliament thought fit to transfer some existing burden from occupiers to owners, or to impose a new rate to meet some new expenditure.

One naturally asks whether such an extraordinary proposal is justified by any evidence led before the Committee, and I have read the evidence of those in favour of the so-called principle of the Glasgow Bill in the hope of tracing the genesis of this proposal. The case of *Dunbar's Trustees* was brought under the notice of the Committee by two witnesses—Provost Keith, of Hamilton, and Mr. Edwin Adam, advocate, Edinburgh—and the argument which Provost Keith based upon it was able, and, in one sense, convincing. It was that if, as the Glasgow Bill proposed, a new and additional tax was to be imposed upon land, then *that* was a burden of which the superior might fairly be asked to bear his share, *because* it was new and additional, and was different in nature and incidence from any taxes already existing. I confess to some sympathy with that argument. If, as I have all along maintained, the Glasgow Bill meant the appropriation of private property in land, it was only fair that the superior should bear his share of the loss. It would not be fair that the vassal should continue to pay to the superior the full annual value of the land, part of which had been taken from him.[1]

But that is a very different thing from what is now proposed, and no one more clearly realised that than Provost Keith. In question 2568 he was asked by Mr. Dundas White, "I think you would quite agree that all taxation which was in view at that time either existing or anticipated ought certainly not to be transferred from one set of shoulders to another, but those principles, I take it, do not apply where a new and additional taxation unanticipated at the time comes into play?"

Answer.—"That is the argument, and those who say this is new and additional taxation, I think, put themselves in the position that they are to be taxed by that fact. I think if we put it as a substitution rather than as an addition, we put ourselves out of Court in seeking relief in the position that I have referred to, because we must hold that being a substitution and not an addition, it is one of those burdens which were contemplated at the making of the contract."

Question 2569.—"In your opinion, then, what is commonly called the deduction proposal might equitably be applied to the case of a new or an additional tax, but it would not equitably be applied to a substitutionary tax, substituted for the existing taxation?"

Answer.—"If you start with the premiss that this is a contractual obligation assumed by the feuar, I think that follows as a necessary corollary."

The rating proposed by the Report is not new and additional, but simply in substitution for the existing taxation, and it is against all principles of public morality that Parliament should interfere to break the contract, and throw the burden on the superior for the benefit of the vassal. But the Committee have adopted Provost Keith's argument and used it in support of the very proposal that he condemns.

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[1] But Provost Keith admitted the necessity of making some compensation to the holders of existing feu-duties.

Let me now summarise my conclusions. So far as the actual Recommendations made by the Committee are concerned, no great harm has been done, but they have failed in their duty to give some clear opinion on the main question of difficulty arising out of the separate valuation of land, *i.e.*, whether the valuation is to be according to actual present use or according to the hypothetical or potential best use. But in the various *obiter dicta* to which the Report gives utterance, they have gone out of their way to create anomalies and to increase the difficulties of the subject, (1) by confining it to local rating only; (2) by applying it indiscriminately to all local rates; (3) by extending the proposal to occupiers' rates; and (4) by extending the scope of the new scheme, on so wide a basis, to the country as well as the towns.

Above all, the majority of the Committee, by disregarding the equity of non-interference with existing contracts, have roused an opposition so widespread, so determined, and so absolutely justified that the prospect of that part of their Report, ever being embodied in an Act of a British Parliament is, I dare to say, infinitesimal.

APPENDIX.

Summary of the Report.

After narrating the history of the Bill, the appointment of the Committee, and the taking of evidence, the Reports of the Select Committee on Town Holdings, 1892, and the Royal Commission on Local Taxation, 1901, are referred to; also the Blue Book with regard to taxation of land in New Zealand, New South Wales, and South Australia. Having explained the present system of valuation and rating in Scotland, and given figures showing the relative assessments on owners and occupiers in Burghs, the Committee proceed to describe the proposals of the Bill which they consider to be indefensible. They, however, proceed to express their approval of the principle which underlies legislation of the class to which this Bill belongs (see p. 3 ante).

The direct effect of the change would apparently be a complete redistribution of the burden of rating. Owners *inter se* and occupiers *inter se* will pay the new rate in very different proportions from those according to which they now pay. Owners of valuable land unoccupied or not fully utilised by buildings will pay more, owners of highly utilised land will pay less. The indirect effect will be to stimulate building and improvements, to bring more building land into the market, to lower rents, and to diminish overcrowding. The extent of the redistribution must be matter of conjecture, so that it is absolutely essential that the proposed valuation should be made before the new standard is adopted. Having dealt with the argument that the proposal of the Bill involves double taxation, the Committee proceed to consider the question of Valuation, and point out (*first*) that the valuation must be from the nature of the case purely a matter of opinion, absolute accuracy being unobtainable; and (*second*) that under the existing system the Assessor has a similar problem to deal with in valuing premises occupied by the owners. Reference is made to the system existing in New Zealand and the Australian Colonies and to the Crofters' Holding Act, 1886, and the "betterment" sections of certain English Acts. The Committee consider that the question of special assistance to the Assessor ought to be left to the discretion of each Local Authority, and they come to the conclusion that to lay down specific rules for valuation would probably give rise to the very difficulties which it is most desirable to obviate. The Committee consider that in making the Valuation regard must be had to every restriction validly imposed on the ground, and that where exceptional expenditure has been incurred in preparing a site for building within, say, 20 years of the date of valuation, allowance ought to be made for it. The clause of exemptions might be extended by giving Local Authorities discretionary power to exempt private gardens or open spaces which are beneficial to the community. They also consider that railways, canals, etc., should be excluded, or else that the present system of rating these subjects should not be disturbed.

Dealing with the question of the rating of existing feu-duties, the Report explains the system of feu-holding and the relative rights of superior and feuar, in view of which the Committee find it impossible to accept the view that the superior is not an owner of land, but a mere creditor of the owner with a security over the land. They hold it equally clearly established that the feu-duty is truly a rent for the land. The argument with regard to the violation of existing contracts is quoted in full at page 52. In support of this argument it is further pointed out that to exempt existing feu-duties would create anomalies as between present and future feuars.

The economic advantages expected to proceed from the proposed reform are again summarised, and the question of the effect on the future of the feuing system is discussed. After again referring to the system of valuation of land in Australia and New Zealand, and also to the case of New York, the Committee proceed to summarise their conclusions as follows:—That the new standard of rating, based upon the yearly value of land apart from the buildings and improvements upon it, is sound, and would prove advantageous; that to set it up by estimating the value of land apart from buildings is practicable; that in making the valuation, regard must be had to all restrictions validly imposed on the land and to recent expenditure in preparing it for use; that exemptions such as are proposed in Clause six of the Bill are proper, but that to these exemptions ought to be added railways, canals, docks, piers, and harbours; that so far as both occupiers and owners are concerned, the new standard of rating should be substituted for the present standard, and that within the category of owners ought to be included owners of feu-duties whensoever created. The Committee therefore agree to the following

RECOMMENDATIONS :

1. That the Bill referred to the Committee be not further proceeded with.

2. That a measure be introduced making provision for a valuation being made of land in the burghs and counties of Scotland apart from the buildings and improvements upon it, and that no assessment be determined upon until the amount of that valuation is known and considered.

STATEMENT I.—City of Glasgow.

Comparison of properties, 190 and 186 West George Street, Glasgow.

PROPERTY.	RENTAL.	PRESENT MUNCIPAL ASSESSMENTS.		
		Owners 1/ per £.	Occupiers 2/9 per £.	Total.
190 West George St. (Ocean Chambers),	£2,002	£100	£275	£375
186 West George St. (Keydens & Co.),	£275	£14	£38	£52

PROPERTY.	ESTIMATED LAND VALUE.	ESTIMATED MUNICIPAL ASSESSMENTS.		
		Owners 2/8 per £.	Occupiers 6/11 per £.	Total.
190 West George St.	£630 (being 4% on price paid, £15,750, for ground and old buildings).	£84	£218	£302
186 West George St.	£315 (area being roughly half that of Ocean Chambers).	£42	£109	£151

STATEMENT II.—PARISH OF CADDER.

Shewing probable Land Value.

	PRESENT VALUATION.	ESTIMATED LAND VALUE.
Agricultural Land, - -	£15,900	£8,000
Minerals, etc., - - -	11,400	2,000
Railways, etc., - - -	12,000	2,000
Other Subjects, - - -	41,700	6,000
Total, -	£81,000	£18,000

Parish and County Assessments on Present and Proposed Valuations.

	ON PRESENT RENTAL PER £.			LAND VALUE PER £.		
	Owners.	Occupiers.	Total.	Owners.	Occupiers.	Total.
Parish Rates,* - -	1/	1/0½	2/0½	3/11	3/5	7/4
County Rates,*† -	9¼	6¼	1/3½	3/5	2/	5/5
Special District Rates, -	1/5¼	1/5¼	2/10½	6/6	6/6	13/
Totals, -	3/2½	3/	6/2½	13/10	11/11	25/9

* Certain apparent discrepancies in these figures are due to the system of deductions for rating purposes. These presumably will not apply under the new standard of rating.

† In estimating the County rates per £ of land value, the above figures of present valuation and estimated land value of Cadder Parish are assumed to express the probable comparison of rental and land value for the whole Lower Ward of the County of Lanark—figures for which are not available.

I am much indebted to the various rating authorities for information kindly supplied, and to Mr William Kennedy, who, by the kindness of Messrs John Mann & Son, C.A., has taken great pains in preparing and collecting these figures.

The Santals of Bengal. By James M. Macphail, M.A., M.D.

[Read before the Society, 16th January, 1907.]

Among the nine million inhabitants of India variously described as aborigines, jungle people, demon-worshippers, or animists, the Santals form the largest tribe. When the Census was taken last, in 1901, they were estimated at 1,830,143. As the total number of "animists" in Bengal was put down as 2,780,468—equal to about 3½ per cent. of the population of 78 millions—it is evident that the Santals are by far the most important section of this division of the people.

As regards their habitat, we use the term Santalia to denote generally that part of the country where Santals are found. It is not a very exact geographical expression, for the Santals are distributed irregularly over a very wide area, like the Highlanders in Scotland. Roughly speaking, the Santal country lies in the angle formed by the Ganges and its main effluent branch the Hooghly, north-west from Calcutta, just beyond and just within the Tropic of Cancer, from 85° to 88° E. of Greenwich. The country is hilly, the highest summit, Paresnath, 4,479 feet, being a few feet higher than Ben Nevis, and intersected by many rivers which are usually expanses of yellow sand in the cold and hot seasons, but become swelling floods in the monsoon. It is the junction of the largest of these rivers, the Damooda, with the Hooghly, that gives rise to the sandbank known as the James and Mary, the most formidable of the many treacherous shoals that impede the navigation of Calcutta's waterway. The more remote parts of the district are still covered with forest, which is rapidly disappearing, especially along the railway lines, with the advance of civilisation. The tree most characteristic of the district is the *sal*, sacred to the Santals. The banyan and other members of the fig family, the *simul* or Indian cotton tree, the tamarind, the *nim*, the Persian lilac, various palms,—especially the palmyra and the toddy,—the mango and the jack, the *mohwa* (*Bassia latifolia*), —upon the flowers of which the poor people live for many months,—these are some of the principal trees. Rice is the

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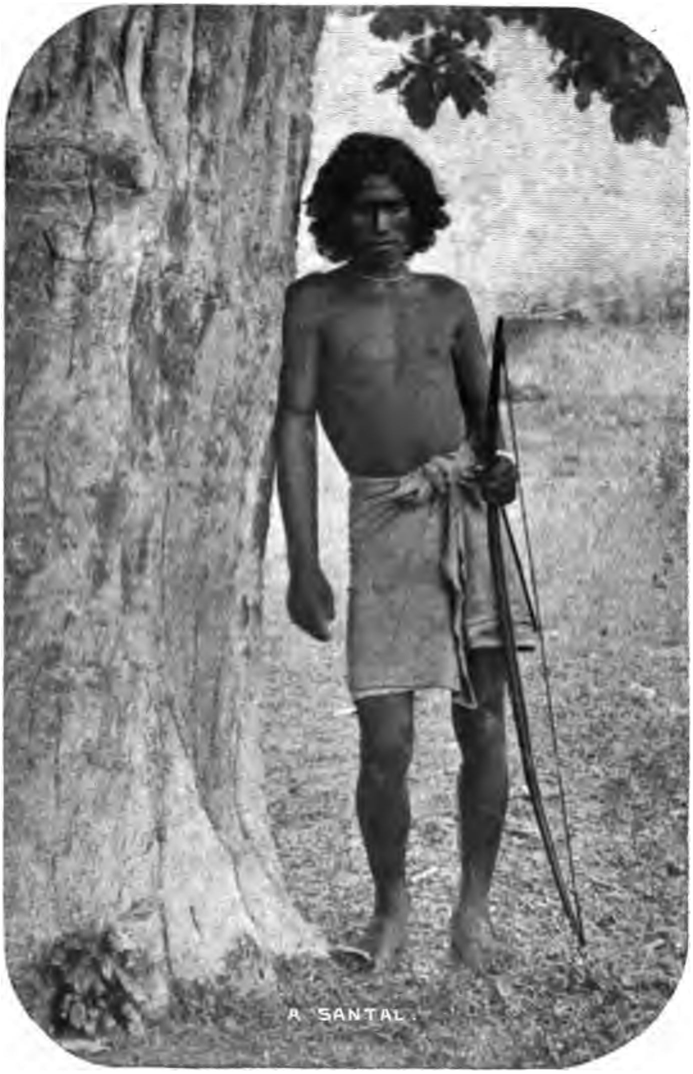
PLATE II.



A SANTAL.

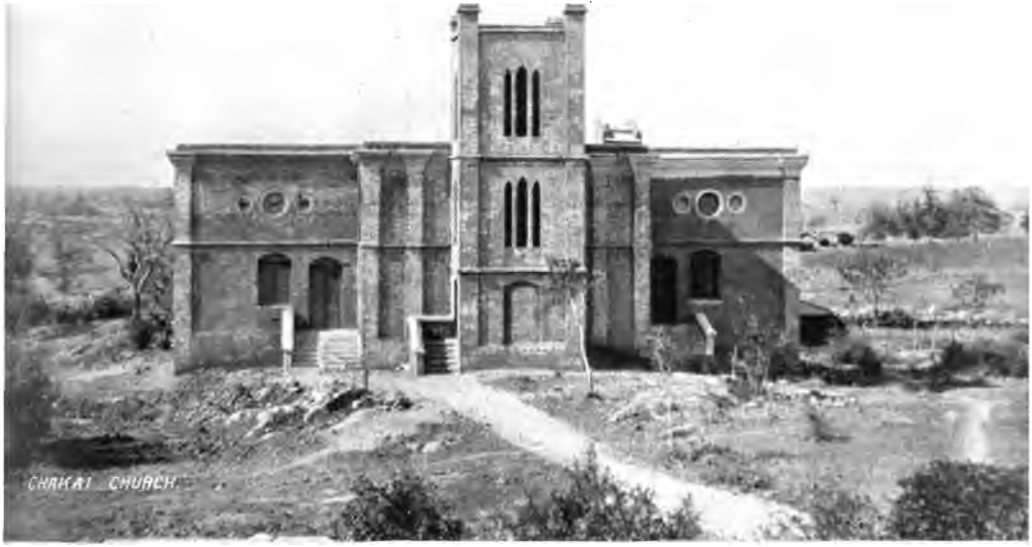
favourite crop wherever there is sufficient moisture. The Indian corn and a variety of millets are grown on the higher land, as well as a number of oil seeds, including castor oil, mustard, linseed, and Niger oil. Wheat, barley, and cotton are grown in small quantities, in certain districts opium, and tobacco is grown very generally as a garden crop. There are a few vegetables, such us brinjal and sweet potatoe, and the potatoe itself is becoming popular. The only other crops of much importance are those grown for the fibre, for string and rope making. Coal is the principal mineral, but mica, iron, and copper are also found, and gold exists in traces. The soil is not the rich alluvial of the Gangetic valley, but the "laterite," sandy, stoney, and dry, with masses of black rock breaking through at intervals. The rainfall averages about 50 inches. Most of it falls in the rainy season, from the middle of June till the end of September, but practically the only rainless month is December. The humidity is less than in any other part of Bengal. The temperature may fall almost to freezing point in January, but often rises to 112° in the shade in April or May, when the hot dry wind blows from the west like blasts from a furnace. Historically this district has always been a border land, marking the point where Bengal merges into the North-West and Bengali and Hindustani intermingle. The local rajahs are chiefly ghatwals, or pass-keepers, who hold their lands in return for services in keeping raiders and robbers in check.

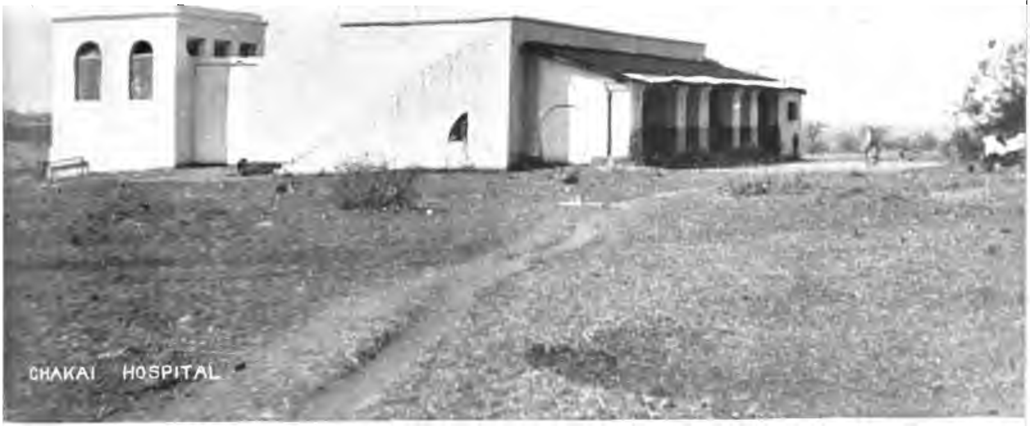
To return to the Santal people, their origin is obscure, but they are as distinct from the Hindus and Mohommedans as it is possible for people living under the same climatic conditions to be. The aboriginal tribes of India are divided by ethnologists into three groups—the Dravidian, the Kolarian and the Thibeto-Burman. According to Mr. H. H. Risley, whose *Tribes and Castes of Bengal*, recently published by the Bengal Government, is now regarded as the authoritative work on the subject, the Santals are "typical examples of the pure Dravidian stock." A theory that they are of Mongolian origin is refuted by the fact that their skulls are dolichocephalic, while the Mongolian skull is brachycephalic. The direction from which the Santals have wandered to their present abode has for long been a subject of discussion. It seems most probable that they have wandered down the valley of the Ganges from the north-west. Dark, often almost jet black in colour, with coarse, often curly, black hair, sturdily built, with fine muscular development, and broad but not unpleasant features, they are wiry and vigorous, perhaps lazily inclined, but capable of great endurance, and very fond of a free, active, open-air life. Five feet seven inches is about the average height, and eight stones the average weight.

Santal traditions tell how the world was created at the beginning out of a great watery waste. Ineffectual attempts had been made by the Crab and the Earth Worm King, but in the end the Great Spirit—*Marang Buru*—succeeded, with the aid of the Tortoise, in raising the earth, and grass seed was sown to make it firm. Then the first human pair, Pilchu Haram and Pilchu Budhi, were born from two eggs laid by a wild goose. The Great Spirit clothed them—ten cubits of cloth for the man and twelve for the woman—and showed them how to brew rice beer from the yeast he gave them. Seven sons and seven daughters were born, and so the race was established. But afterwards, when a deluge of rain-fire destroyed the inhabitants of the earth, a single pair were preserved in the cleft of a mountain. After that, as the race multiplied, the Great Spirit became jealous of them, for they all spoke the same language and lived together in peace and happiness. So He contrived a plan to sow dissension among them —*divide et impera*—that He might rule them more easily. He summoned the people to run a race for prizes he had prepared. These were five in number, consisting of various kinds of food in leaf cups of different sizes. In the first was beef, in the second goat's flesh, in the third fish, in the fourth bananas, and in the fifth rice and milk. The man who came in first naturally chose the beef, and he became the progenitor of the Santal race. The second man got the goat's flesh, and founded the Mohammedan community. The man who got the fish originated one caste of Hindus, and he who won the plantains another. The last to arrive had to be content with rice and milk, and became the father of the Brahmins. Another tradition suggests that at some former period the Santals were at least in contact with a higher civilisation than they have known in recent times. In those days, they say, they were called Kherwars, and were a wealthy and powerful people, owning the land they cultivated, with Kings and armies of their own. Nor in those days were they demon. worshippers. One of their Kings took a concubine from a gipsy tribe—the *Birhors*—and a child born of this alliance was named Madho Sing. He was born in the jungle, where his mother and other women were gathering the tender bamboo shoots which are still used for food. The other women asked the mother, "Which are you going to take home, the bamboos or the child?" She replied, "I shall have many more children, but who knows if I shall find more bamboos?" So she covered the child with leaves and left him. That evening the King's four daughters, with their girl friends, were walking in the jungle, and hearing the child's cries, they carried him home and adopted him. When Madho Sing grew up, he became the King's *Dewan* or Prime Minister, collected all his rents, and carried a golden umbrella. One day he said to the king, "Get me a wife, or I shall marry one of your daughters by force." So the King asked his people to provide a wife for Mahdo Sing, but they all refused, saying nobody knew who his father was or to what tribe he belonged. Then Mahdo Sing said he would marry whom he pleased by force, and the people said, "Come, let us flee, or he will defile us all." To make a long story short, in their flight through the forest they were stopped by a flooded river. They began to pray to all the objects around them—stocks and stones, trees and shrubs, promising to worship any of them who would help them across. Nag and Nagin, a serpent and his mate, responded, and kept back the river with their bodies until they were all across. In the same manner the demons they invoked opened stone doors that barred their way. When they reached their destination each family was advised to kill a bullock, eat its flesh, and use the hide as a roof for a temporary dwelling-place. Madho Sing pursued them, but when he saw traces of the demon-worship and the cow-killing, his scorn knew no bounds. "You are no more Kherwars," he said, "your caste is gone,—you are vile cow-killers." So ended the Santals' golden age, for the return of which they have ever since been longing in vain. Among them political agitation has for its main object the abolition of rent. They have had many wanderings, and wherever they have gone they have danced the ground hollow, drank the water springs dry, and eaten the very grass off the face of the earth. In fact, if degeneration has been the keynote of their history, it sits very lightly upon them. They are supremely well pleased with their present condition. In their own language, the word for a Santal is a *man*; and the free and independent spirit of the people has hitherto saved them from the fate that has overtaken most of the aboriginal tribes of India, of becoming hewers of wood and drawers of water to the caste Hindus. Of course, from the Hindu point of view, the Santal is an out-caste,—but then the Hindu is an out-caste from the Santal point of view. In one respect the Santal is much more catholic than Hindu or Mohammedan,—he will eat anything. In India it is considered a mark of degradation to eat the flesh of animals that have died of disease, or even by accident; and of this the Santal must certainly plead guilty.

The Santals are divided into twelve sub-tribes or septs, of which seven have existed from the beginning, being descended from the seven sons of Pilchu Haram and Pilchu Budhi. The five subsequently added have originated in different ways. Two, for example, are named after the pigeon and the lizard, the tradition being that these names were first applied as nick-names to some members of a big hunting party who succeeded in killing nothing but lizards and pigeons. Each sept has a pass-word or shibboleth peculiar to itself. These septs, again, are divided into an almost indefinite number of sub-septs.

The religion of the Santals is demon-worship. Outside each Santal village is a sacred grove of fine trees—the sacred *sal* tree. The principal demons or *bongas* are represented by half-a-dozen pieces of quartz daubed with vermilion, placed at the foot of these trees. Sacrifices of fowls, sheep, goats, and even cows or buffaloes —and occasionally in former times human beings—are offered here at certain festivals and in times of sickness or other calamity. Combined with this there is a form of ancestor-worship. In the main street of the village is a small shed supported on five wooden posts. At the foot of the central post, a roughly carved piece of wood or stone represents the spirit of the deceased village chief, and sacrifices are offered to him as well. But these by no means exhaust the list of demons. Everything mysterious, everything disastrous is due to demon agency. Demons people earth and air and water, and every household has a private demon of its own, whose name is kept secret by the head of the family till just before he dies, when he whispers it to his eldest son. The object of this secrecy is not to give offence to other demons, who are all consumed by jealousy. A newly married bride, on being introduced to her home, goes through a form of marriage to the demon of the well or spring, in order that the water may give life and health, and not disease and death to those who drink it. This demonology also explains the custom of giving each child two names, its real or "inner" name, which is kept secret, and its "upper" name, by which it is known to the public. If the


CHAKAI CHURCH.


CHAKAI HOSPITAL.

demons knew the child's real name, it would give them too much power over it. Then the upper name is often an opprobrious one,—"Rags" or "Rubbish," *e g.*,—as least likely to excite the cupidity of the demons. Of the future life the Santals' ideas are exceedingly hazy. Every male must have a number of marks burned upon the extensor surface of the left forearm, and every female must have the arms and chest tatooed. Unless this is done, huge worms as thick as tree trunks will devour them after death. After death the body is burned, but a number of charred bones are carefully preserved in an earthenware pot by the nearest male relative until it is convenient for him, accompanied by other relatives, to carry them to the Damooda river, to the waters or sands of which they are committed, with ceremonies that signify that all has been done that filial duty demanded. The Santals speak of *Jom Raj* as the King of Death, but this is evidently borrowed from Yamah, the Hindu god of Death. In the future world, all departed spirits are engaged in grinding the bones of the dead, from which the bodies of new born infants are supposed to be made. Only two excuses procure exemption from this toil —if the men say they are preparing tobacco for chewing, or if the women plead that they are nursing babies.

While the religion of the Santals is entirely one of fear, with very little moral significance, their character compares not unfavourably with that of many of their more highly civilised neighbours. They possess, in perhaps an exceptional degree, the primitive virtues of courage and honesty. Among themselves a word is as good as a bond. A knot tied on a piece of string serves as a receipt. Their social code is strictly defined. In every Santal village there is an official, the *jog manjhi*, who is the custodian of the morals of the young people. Any woman wronged by a man can appeal to him for redress. It is rare for a a child to be born out of wedlock. A man who has led a girl astray must either marry her himself or provide a husband for her, and this he does by settling upon her a dowry sufficiently large to make it worth somebody's while to marry her. If already married he can take her as a second wife—bigamy being quite regular although not very common, few Santals being in a position to maintain more than one wife—or he may at least take her into his home in order that the child may be born as his legitimate son, and then give her a present of a cow and let her go. The women enjoy considerable freedom, but they are regarded very much as a marketable commodity, and the price of a wife is about a third that of a cow. Divorce is easy. A leaf is torn in two—one portion given to each party, and they are free. If the wife is not present, an earthenware pot, into which the half-leaf is put, is taken to represent her. But, in fact, if a man's wife runs away he is, *ipso facto*, free to marry again. Family feeling is strong, but apart from kinship there is hardly such a thing as friendship. The language, in fact, does not contain a word for "friend" in our sense of the term.

Their language is the most remarkable possession that this people, exceptionally poor in this world's goods, can boast of. It is a triumph of complexity, with moods and tenses all its own, difficult to learn except by living among the people, but when once mastered peculiarly expressive and convenient. It was only reduced to writing by missionaries between thirty and forty years ago, the Roman character being used with the addition of a few diacritical signs. The most striking peculiarity in pronunciation is a series of what we call half letters—*c'*, *p'*, *t'*, and *k'*—as in *lac'*, *durup'*, *met'*, *dak'*, and there is a curious nasal, like the *ñ* in Spanish. As regards grammar, the language belongs to the agglutinative or compounding type. It consists of roots rather than words, and every word can be made to serve any part of speech—noun, verb, adjective, or adverb. There is a dual as well as a plural—and the first personal pronoun has both in the dual and the plural two forms, one inclusive, the other exclusive. Thus, for the English *we* there are four words in Santali—*alin'*, you and I; *alan*, I and someone else; *ale*, we, not including you, and *abo*, we, including you. Then the case is further complicated by the fact that both the subject, object, possessive, and dative are included in the verb. *In' Dalkedan'* = I struck. *In' dalkedean'*, I struck him; *In' dalkedetœan'*, I struck him, who is his, etc. There are two aorists, one which implies that although an act took place in the past, something has occurred to abrogate or cancel the action. *Hec' enae* means he is come. *Hec' lenae* means that although he came he went away again. The vocabulary is very rich in concrete, natural terms and very deficient in general and abstract terms. There is no word for "cousin," for example, but a different term is used for each of the relationships, maternal and paternal, male and female, which are included in that English word. There is no verb with so vague a meaning as the English verb "to fall." There is one word that means to fall from a standing position, another that means to fall from a height, and so on. A dictionary of the Santali language recently published contains over 20,000 words.

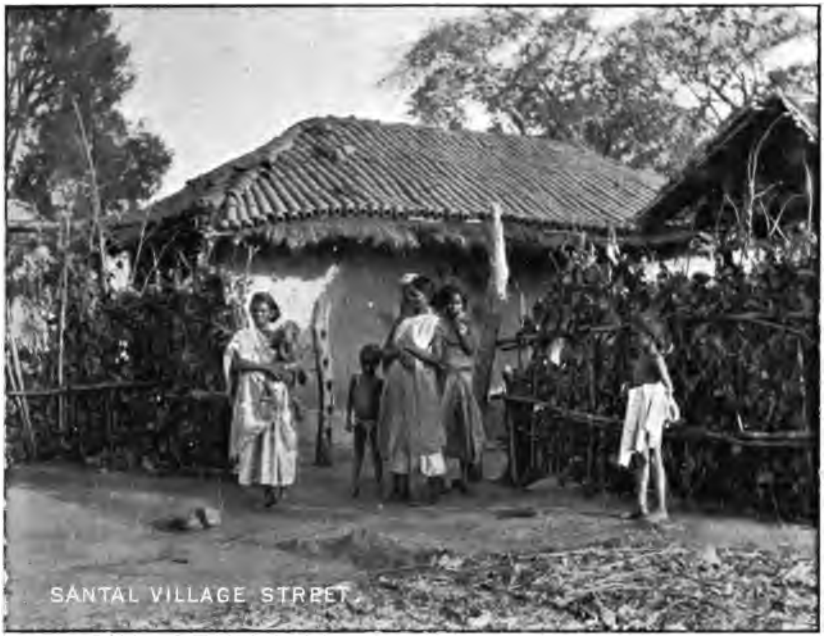
Santal village life is on the patriarchal system. There is a village chief, who leases the village from the landlord and sublets it to the ryots or cultivators. He is also the head of the social system. In the exercise of his authority he is assisted by the *paranik* or assessor, by two priests and by the custodian of morals already referred to. There is also a messenger whose duty it is to summon to the chief anyone who is wanted, and also to act as a guide to travellers. These officials receive land rent free in return for their services. People dissatisfied with the decision of a village chief can appeal to an overchief of a circle of villages, and from his ruling to the big chief of the whole countryside; but the supreme court of appeal is the whole community as it assembles for the big annual hunt. After hunting all day the people bivouac at night in the jungles, and knotty questions of the law are then discussed and finally settled. A branch of the sacred *sal* tree, handed round from village to village, with a leaf for every day that is to elapse before the meeting, serves as a summons to these great hunts, or to any other muster of the clans. By means of these village councils many disputes about marriage, divorce, inheritance, and the division of property are settled which would otherwise involve expensive and vexatious litigation.

Infant marriage is not practised among the Santals, but a lad is invariably married soon after puberty to a girl of about the same age. The first and most inexorable of their marriage laws is, that a man cannot marry within his own tribe. Exogamy is imperative; no sin the Santal can commit is visited with such severe penalties as a breach of this rule. It means social ostracism and outlawry. The choice of a partner for life is regarded as much too important a matter to be left to the young people themselves. The parents of a lad ask the old men of the village, with the *jog manjhi*, to take the initiative. They almost always look for a bride in another village. They approach the old men of the prospective bride's village with the query, "Have you any diamonds to sell?" "That depends upon the quality of your pearls," is the stock answer. And so they go on, talking to each other in parables for a whole afternoon, till a bargain is struck. Five rupees, or six shillings and eightpence, is the usual price of a bride (half for a widow, who must rejoin her first husband in the next world).

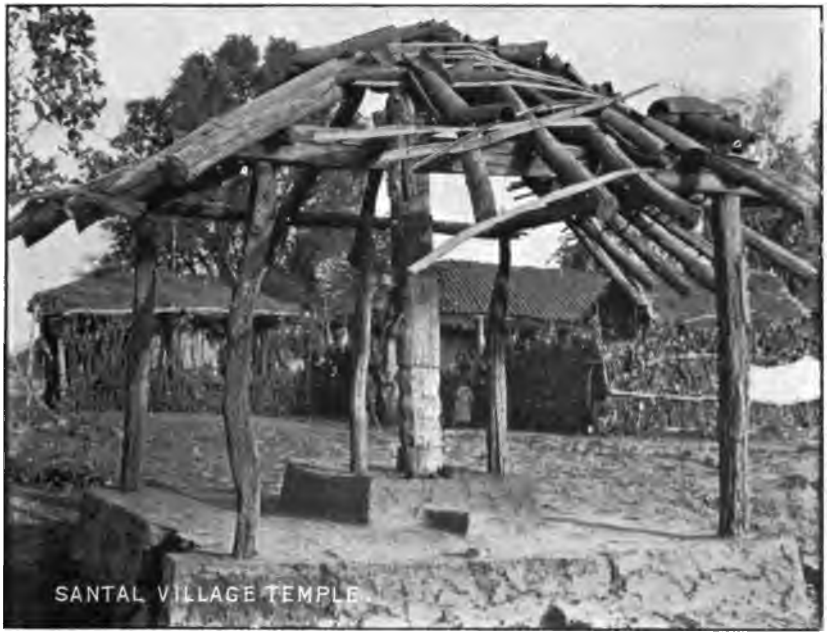
Afterwards, the youth's friends visit the girl and give her a cloth as a sign of betrothal. The paying of the price to the bride's parents is the occasion for further ceremony, and then the date of the wedding is fixed. Knots are tied in two strings equal to the number of days that will pass before the wedding day. Each party keep a string, and a knot is untied every morning. The untying of the last knot means that the great day has arrived, and it is then, in many cases, that the future husband and wife see each other's faces for the first time. The marriage is celebrated with great merriment and royal feasting. Goats are killed, home brewed rice beer is drunk, and the singing and dancing are kept up for days and nights on end.

This is the ordinary orthodox course of true love, according to Santal ideas, but exceptions are by no means rare. It is called "Buying the Bride." But there is another recognised form of marriage known as "Buying a Husband" (already referred to), in which a husband is bought for a young woman by the man who ought to marry her but is prevented from doing so, either because she belongs to his own tribe, or because he has a wife already who dares him to introduce a rival to the house. There are two other quite legitimate, but not very respectable forms of marriage known as Paint Smearing and Running In. In the former, a youth forcibly seizes a maiden, whose parents are opposed to the match, as she is drawing water at the well or gathering firewood in the jungle, and smears red paint on her forehead at the parting of the hair. In "Running In," it is the maiden who assumes the aggressive and carries everything before her. If she has the boldness and the physical strength to force her way into the house of a youth whose parents are opposed to her, and if she can manage to stay there all night and brazen out all the abuse that is heaped upon her, she usually wins the day. There is still another form of marriage for a girl who is deformed or in other ways unattractive No price is paid for her, but the young man serves the father-in-law for five years, then gets two bullocks, some rice and tools, and goes his way. As already indicated, widows may remarry—for this life.

The costume worn by the woman is the *sari*, a piece of cotton cloth, about a yard wide, and, if she can afford it, six yards long, thrown over the shoulder, brought under the opposite armpit, and fastened at the side. The men, when at work, just wear a waist cloth, but when visiting friends or going to market they wear another cloth



SANTAL VILLAGE STREET.



SANTAL VILLAGE TEMPLE.

thrown over the shoulders like a plaid. When they become well-to-do they imitate the Bengali costume. The women are very fond of brass ornaments, worn on fingers, wrists, arms, neck, ankles, and toes. It is not uncommon on a gala day for a girl to wear ornaments weighing altogether 14 pounds or more. They deck their hair with flowers, and sometimes when dancing at night, with fireflies, and both man and woman luxuriate in oil with which they smear not only the hair but the whole body as well. A Santal will sell his soul for a little turpentine, of which they are inordinately fond.

The work in which the Santals excel is reclaiming waste land. Selecting some remote spot in the jungle, where no one but themselves could live, they begin to clear the forest, ploughing among the stones, and ekeing out their scanty living by gathering wild berries and hunting. Once his land has become worth cultivating, the Santal is apt to fall into the clutches of the wily Hindu money-lender, who advances him money, say at 300 per cent., and then seizes his land in payment, with his own services thrown in. Or the rent, which was at first nominal, is increased by the landlord. The Santal, often too ignorant to see through the wiles of the money-lender, and too poor to fight against his landlord in court, flits by moonlight to some still more remote region, to begin the laborious process over again, reclaiming jungle for the benefit of the landlord, tilling fields to fatten the money-lender. Education is still at a low ebb among the Santals. Their instincts and ambitions are not literary.

> " Iron-jointed, supple-sinewed, they shall dive and they shall run,
> Catch the wild goat by the hair, and hurl their lances in the sun ;
> Whistle back the parrot's call, and leap the rainbows of the brooks,
> Not with blinded eyesight pouring over miserable books."

That still represents the Santal's ideal of juvenile happiness. According to last census (1901), of every 1000 males, 994 were illiterate, and of every 1000 females, 1000. Numerically, however, they are making rapid progress. In ten years they increased 24½ per cent., while the general increase in Bengal for the same period was only 4 per cent.

The most important event in the recent history of the Santals was their rebellion fifty years ago, in the year 1855. Exasperated beyond endurance by the exactions of the money-lenders and the landlords, they rose in a body, 30,000 strong, with the object of marching down to Calcutta to lay their grievances before the Governor-General. Unwise interference on the part of the police, who attempted to arrest the leaders on a false charge, led to an outbreak of hostilities, and the Santals getting beyond the control of their leaders, took to indiscriminate slaughter and pillage. Many an old debt was wiped out in the days that followed. The oppressors had good measure well shaken, pressed down, and running over, returned into their bosom. Not a money-lender or a landlord was left alive in the track of the storm. Troops were marched up from Calcutta, and as the Santals knew nothing of the usages of civilised warfare—their slender military equipment did not include the white flag—and as nobody understood their language—they were shot down often to the last man. "They were," wrote Major Jervis, "the most truthful set of men I ever met; brave to infatuation. A lieutenant of mine had once to shoot down seventy-five men before their drums ceased and the party fell back." None but wounded men were taken as prisoners, and they bitterly upbraided our officers for having fought against them on the side of their oppressors. Not till 10,000 men were slain was the rebellion quelled. Old men among the Santals still reckon time from this rebellion, which marked the beginning of a new era in their history. The Government enquired into their grievances, and set apart a certain district, called the Santal-Parganas, in which they are under special legislative protection. Then the quickening of the national conscience, as a result of this uprising, and still more of the great sepoy mutiny two years later, found expression in the inception of that missionary work which, apart from or in addition to its directly religious value, has exerted a powerful educative and civilising influence on the people. At least 30,000 Santals have become Christians, forming a community materially, morally, and intellectually far in advance not only of their fellow-tribesmen, but also of many of their neighbours who occupy nominally a much higher position in the social scale. To take, for example, the one matter of female education, the Christian Santals in this respect now rank third among all the tribes and castes of Bengal, and one of the two castes above them are of mixed blood, being descendants of the Portuguese pirates who once infested the Bay of Bengal. The proportion of the literates among the female Christian Santals is 151 per 1000. Among the non-Christian Santals it is *nil.* Among the Brahmins it is 26 per 1000. This an indication of what has already been accomplished, and also a forecast of still greater things which we trust will be accomplished in the future.

On the History and Development of the Natural History Collections in the Glasgow Museums. By PETER MACNAIR, F.R.S.E., Curator of the Natural History Collections in the Glasgow Museums; Lecturer on Geology and Mineralogy in the Glasgow and West of Scotland Technical College; Honorary Secretary of the Glasgow Geological Society.

[Read before the Society, 5th December, 1906.]

IT is something like thirty-six years since the old mansion house at Kelvingrove, which is now demolished, was opened as a temporary museum for the purpose of exhibiting Natural History, Ethnographical, and Technological specimens. Mr. James Thomson was appointed curator, and having a strong love for natural history, he set himself with the greatest enthusiasm to bring together a collection illustrative of the different branches of British natural history. The collection of British birds that he made being specially deserving of notice, formed the basis of the present collection.

Unfortunately the space at his disposal was exceedingly limited, and as he had also to house in the same small building a wide range of industrial and ethnographical specimens, it will be seen that at the very outset our museums must have been handicapped for want of space.

In the year 1874 the following minute was passed by the Sub-Committee on Museums :—"The Committee having considered that the space for exhibition in the Museum is exhausted; that such an institution, as a means of imparting education and enjoyment to the community is most invaluable; that the accommodation should be extended; and that as there is no assessment or public fund available to provide an extension, recommended that permission should be given by the Town Council to the Committee to extend the Museum, after sufficient funds for that purpose have been raised by voluntary subscription, and the plans have been approved of by the Council."

This minute received the unanimous approval of the Town

Council on the 4th March following, and thereafter a public subscription was organised from which ultimately a sum of £7,500 was obtained. To this a sum of £700 voted by the Town Council for an aquarium was added, bringing the total sum available for building purposes up to £8,200.

In the year 1876 the new wing of the Museum was opened with an exhibition of local industries, in connection with the meeting of the British Association in Glasgow for that year. As this collection was entirely of a technological character, no reference need be made to it here.

The new wing of the Museum—with the exception of that part set apart for the Aquarium—was almost entirely devoted to the housing and development of the technological collections, the old Museum being reserved for the mineralogical, geological, natural history, ethnographical, and archæological collections, so that for the long period of thirty-two years the development of the natural history collections had to be confined to a portion of that small building.

Notwithstanding the exceedingly adverse circumstances brought about by the limited amount of accommodation afforded for the housing and classification of specimens, the collections at once began to grow, and when Mr. Paton joined the staff as Superintendent of Museums, a large number of British natural history specimens had already been accumulated. Principally through the good services of Mr. Paton, a valuable collection of natural history specimens from Dutch Guiana were at this time presented to the Museums, and they may be said to have formed the nucleus round which the present foreign collection accumulated in the course of time.

Within the last ten years, a number of branch museums have been opened in different parts of the city, and in these small type collections of natural history have been placed.

The most important phase in the development of the Municipal Art Galleries and Museums will now be briefly referred to. The great risks to which the Art collections were exposed from the insecure nature of the Corporation Galleries in Sauchiehall Street made it imperative that something should be done for their safety, therefore in 1886 the suggestion was thrown out that, by the holding of a great temporary exhibition in Kelvingrove Park, a sum of money might be realised that would at least form a nucleus for the raising of an adequate fund for the erection of a

Gallery of Art and Museum worthy of the city. The exhibition was a great success, and the sum derived from it was afterwards more than doubled by private subscription. As a result, the present building in Kelvingrove was erected at the cost of over a quarter of a million.

As it stands, the building consists of a central hall 125 feet by 56 feet, with two courts each 102 feet by 60 feet, these courts being situated east and west of the hall. There are twelve galleries arranged in two floors around the courts with eight pavilions at the corners. The galleries average 100 feet long by 28 feet wide, the upper galleries being specially adapted for the show of pictures, for which purpose they have been set apart.

When we consider the variety and quantity of the different collections that had to be exhibited in the Museum portion of the building, it must be admitted that a very liberal allowance has been made to the natural history collections; thus one of the large courts, two of the long galleries, and two of the pavilions were set aside for the departments of Mineralogy, Geology, Botany, and Zoology.

I now pass to a brief description of some of the more important Mineral, Geological, Botanical, and Zoological collections that have been acquired by the Museum since its inception. Glancing first at the geological collections, I may say that, previous to the year 1896, very little had been done in the systematic development of this part of the Museum, and both the general principles of geological science and the geology of the Clyde Valley were represented by only a few isolated specimens. This seems exceedingly strange when we remember that for over half a century the west of Scotland had been famous for its collectors of rocks, minerals, and fossils, who had added many new genera and species to the records of the British rocks, many of which had become classic in the history of geological science. Nevertheless, few specimens seemed to come the way of Kelvingrove Museum. In this connection, it ought not to be forgotten that the Father of Scottish Palæontology, David Ure, the author of *The History of Rutherglen and East Kilbride*, collected, figured, and described many of the carboniferous fossils found in the neighbourhood of Glasgow and the west of Scotland. This collection, I believe, is still in existence in Edinburgh, and since Ure's time there seems to have been a steady gravitation of west of Scotland specimens in that direction. In the year 1896, the Museum Committee purchased the Glen collection of minerals, rocks, and fossils, and this purchase may be said to mark the real beginning of the geological department in the Museum. Mr. D. C. Glen, to whom the collection belonged was a prominent member of the Glasgow Geological Society, and an enthusiastic collector of minerals. He did not, however, confine himself to the collection of minerals alone, but also accumulated a large collection of rocks and fossils. The collection of minerals contains both British and foreign specimens, and we shall presently see that nearly all the specimens of minerals that have been laid out in illustration both of the first principles of that science, and the systematic collection illustrating the different mineral species that occur in the crust of the earth have been derived from the Glen collection. The palæontological material in this collection also supplied the nucleus of the stratigraphical series now at Kelvingrove.

Another important mineralogical collection recently presented to the Museum was that made by Professor Fleming, who was the first Professor of Natural Science in the Free Church College at Edinburgh, and who was a pioneer in the investigation of several departments of British natural history, including mineralogy, geology, and palæontology. The mineral cabinets contain over a thousand specimens, a great many of which are Scottish. Of the local minerals, the cabinets contain a number of fine specimens of Greenockite, and also some finely crystallised zeolites from the Clyde valley and Skye.

Perhaps the most valuable collection in the geological department is that made by the late Dr. John Young. It was purchased by Mr. J. T. Tullis and presented to the Museum, and had the Museum not received this valuable and timely gift our local geology would have been but poorly represented. It is the most complete collection of Scottish carboniferous invertabrata that has ever been brought together, nearly all the genera and species given in the catalogue of western Scottish fossils being represented. Dr. Young confined his efforts entirely to the collection and study of the local carboniferous invertebrata, admitting nothing into his cabinet which did not fall under that category, hence the great value of the collection to those who are interested in the geology and palæontology of the West of Scotland. He laboriously collected the most minute fossil forms, few of which were known to Scotland ere he began his researches, and quickly added large numbers of genera and species to the lists, many of which were new to science. The skill with which he collected and mounted these specimens is evidenced by an inspection of the collection as it is now laid out. Apart, however, from its purely scientific importance, the collection has also a historical value, as it contains a large number of type and figured specimens, the greater part of these being the brachiopods figured and described by Davidson in the various monographs on the carboniferous brachiopoda. There are also in the collection a large number of type and figured specimens drawn and described by Brady, Jones, Kirkby, and others, and it is intended that a complete list of these will be published, so that naturalists may know the whereabouts of the original specimens. The city should feel much indebted to Mr. Tullis for this valuable gift, and as there are still a number of important local natural history collections which it would be desirable to see permanently placed in the Glasgow Museum, it is to be hoped that the example set by Mr. Tullis may be emulated by others, and that we may soon have a representative collection of the great wealth of extinct and living forms which is to be found within the valley of the Clyde.

The collection of graptolites made by the late James Dairon was gifted to the Museum by his daughter, Mrs. Fleming. The collection which extends to many thousands of specimens was entirely the work of Mr. Dairon, to the formation of which he brought considerable geological knowledge and skill, as is evidenced by the papers which he contributed to the Geological Society of Glasgow, and which are published in its "Transactions," many of the papers being illustrated by carefully drawn figures of the fossils. During his lifetime, Mr. Dairon was in close friendship with Professor Lapworth, through whose researches the geological structure of the Southern Uplands was ultimately unravelled, the key to its complicated structure having been supplied by its graptolitic fauna. After having studied these lowly organisms for a considerable period of time, Professor Lapworth was enabled to show that certain forms were characteristic of certain beds, and no matter to what extent these rocks had been twisted and folded, these particular beds could be identified over many square miles of country.

In Professor Lapworth's famous paper published in 1876 on the Moffat series, we find Mr. Dairon's work acknowledged amongst that of others who had assisted in the collection of organic remains from these beds. When once this collection has been laid out, it is hoped to display a fairly representative suite of the different genera and species of graptolites found in the Silurian rocks of the south of Scotland, and thereby enable students of Scottish geology to follow intelligently not only the geological history of the rocks themselves, but also the history of the controversy which is one of the many fascinating pages in the progress of Scottish geology.

Another important collection recently presented to the Museum is a series of 450 sections of local rocks, the work of the late Mr. Arthur Pratt. These were presented by his family. The preparation of these thin slices for microscopic examination must have entailed an incalculable amount of labour and patience on his part, and they form a series of inestimable value for students of the rocks in the immediate neighbourhood of Glasgow.

Time will not allow of my entering into details regarding the remaining geological collection, so that a brief notice must suffice. To the Geological Survey of Scotland we are indebted for a large collection of Scottish rocks and fossils. They were given to the Museum about four years ago, and were specially selected to fill the more glaring blanks in the geological department. Thanks are also due to the Governors of the Technical College for the generous way in which they handed over to our care the type and figured specimens which they had in their museum at the College. Mention ought also to be made here of the fact that for the last seven years a number of local geologists have been energetically working the upper Silurian deposits of the Lesmahagow inlier, all the specimens that were obtained having been handed over to the Museum, the result being that a very complete suite of organic remains, including a large number of the recently-discovered fishes have been added to the Museum collections.

Turning now to give a short description of the more important zoological collections, I have to mention in the first place the fine series of mammals that have been gifted to the Museum by Mr. Bostock, of the Scottish Zoo. These include a large Indian elephant, a lion, a leopard, a pair of pumas, a dromedary, and a great many species of monkeys and other mammals. In most cases we received the carcases of these animals, and their skeletons have been prepared for articulation, a number of them having already been set up. But besides these which have been set up, and which are now on exhibition, we have accumulated a very large number of skeletons, which have been carefully prepared for future use.

As we shall presently see, these specimens have been placed in the systematic collection of zoology, and while they thus serve a strictly scientific purpose, they at the same time form to the general public one of the most attractive and popular sections in the whole Museum.

Another valuable collection of mammals from South Africa has recently been presented to the Museum by Mr. J. M'Niel. These include a female giraffe nearly sixteen feet in height, and many fine heads of African big game. The female giraffe presented by Mr. M'Niel, along with the male recently purchased from Mr. Bostock, will make an extremely interesting addition to the mammal collection.

I have already mentioned that in 1876 a large collection of exotic mammals, birds, and insects was presented to the Museum by the late Mr. Robert Kirke, Greenmount, Burntisland. Two years ago, the trustees of that gentleman handed over to the Museum the remaining part of the collections, which include a fine series of insects, a callection of stuffed birds, birds' nests, and eggs, and mammals from Dutch Guiana, also a cabinet of European lepidoptera systematically arranged, the whole comprising many thousands of specimens.

The time at my disposal will not admit of my entering into anything like a detailed account of the many collections of foreign and British birds, reptiles, fishes, and invertebrates at present in the Museum, a very brief notice of these can only be given here. Amongst a great many minor collections of foreign birds, there are several larger ones of outstanding importance. These include the Bidie collection of Indian birds, and two other extensive collections of African and American birds, the whole amounting to many hundreds of skins, all of which are in perfect condition. The Kirke collection of European birds recently presented to the Museum contains over 320 skins, and the Stewart collection of British birds over 651 skins. A very large amount of material that will be available in the systematic collection of fishes and reptiles has also been accumulated.

Amongst the invertebrates, we have also a number of large and important collections, these can only be enumerated here. They include the Brown collection of British mollusca, and the Glen collection of foreign mollusca. The duplicate collection of the crustacea of the Clyde, made by the late Dr. Robertson, the Young collection of spiders, the Kirke collection of European lepidoptera, and the Colquhoun collection of British lepidoptera, the late Dr. Robertson's collection of the Clyde foraminifera and microzoa generally will, when worked up, also fill up many of the lacunæ at present observable in the collections.

I must dismiss the botanical collections with a single word. The representative collections of British and exotic plants that this Society presented to the Museum still remain the most important part of the botanical section. Other collections have recently been added, and include those made by Mr. Horne, Dr. Fleming, and the Andersonian Naturalist's Society.

Proceeding to a consideration of the classification and arrangement of the Natural History collections at Kelvingrove, let me say that from the outset a very definite scope, plan of arrangement, and method of classification has been adopted. It must, however, be kept in mind that the building was not originally specially designed for the display of natural history collections, nor was it fitted up as natural history museums usually are with cases and cabinets that have been constructed so as to conserve or show to the greatest possible advantage the many different kinds of specimens that have to be treated in a natural history museum. Another difficulty which had to be faced at the very outset was that, notwithstanding the liberal amount of space that had been alloted for natural history purposes, it was evident that certain of the collections would have to be crammed into a gallery wholly inadequate for its present reception without thinking of future development. This was particularly evident in the case of the British room.

Within the last five years, then, a deal of time has been spent in considering how a natural history collection, based upon the scheme that had been drawn up, and having some show of proportion and symmetry, could best be arranged in the available space and with the available cases. As we have already seen, when the apportioning of the different galleries in the Museum was under consideration, it was resolved to devote one court, two galleries, and two pavilions to the natural history section, and it is in this space that the collections have been arranged at present. As regards the scope of the collections, we hope to include the four great divisions of natural science—mineralogy, geology, botany, and zoology—each of these divisions containing two collections—an introductory collection and a systematic collection. These collections would represent the educational aspect of the museums, while the purely scientific side would be confined to the development of a complete suite of specimens illustrative of the fauna, flora, geology, and mineralogy of the British Islands, beginning first with that of our own Clyde valley and the west of Scotland.

In the Introductory collection the first principles of the natural sciences are set forth as far as it is possible to do so in a museum, by the adoption of a carefully selected plan usually following some of the standard text books, by the careful selection of specimens, models, and diagrams, and by descriptive labels. In the systematic collection, as complete a series as space and material will allow have been laid out in illustration of the different species of minerals, rocks, plants, and animals, these having been arranged as far as possible in linear order, and according to the most recent standard of classification; the different groups, sub-groups, and genera being distinctly marked off with labels, the species bearing simply the name and locality where it was found. Our purpose, then, is to elaborate the introductory collection in considerable detail with descriptive labels, specimens, and models, so that they may be of the utmost value to all students of natural science. It will also be our aim to make the systematic collections as complete as possible. Something has already been done in the development of the zoölogical and geological collections along the lines which I have just indicated, and I venture to lay before you a short description of these, so that you may judge for yourself the merits or demerits of the scheme.

Thirteen cases, each having two sides, and practically forming twenty-six cases, have been set aside for the introductory zoological collections. The cases have been designed so that the student can examine most of the specimens without stooping, and, at the same time, read the descriptive labels with ease and examine the specimens, models, and diagrams to the greatest advantage. I cannot enter into anything like a detailed account of the collection at present. At the end of the paper I shall place some photographs upon the screen which will give you a better idea of what the arrangement is than any detailed description could possibly do. Seven of the cases are devoted to typical invertebrates, and include representatives of the following divisions:—Protoza, illustrated with models and diagrams; porifera, cœlenterata, echinodermata, vermes, crustacea, arachnida, insects, polyzoa, lamellibranchiata, gasteropoda, cephalopoda. The vertebrates are shown in six cases, and include two typical fishes, an amphibian chelonian, a bird, and a mammal. In every case the most common and easily obtained, and, at the same time, most typical form, has been selected, and though the collection is very far from completion, and very far from what it ought to be, yet we have had abundant evidence of its usefulness to all classes of students who are studying natural history. This collection has been laid out in the large court.

The systematic collection of zoology is at present confined to the large court, and one of the long galleries, the mammals being placed in the court and the lower vertebrates and invertebrates in the long gallery. I think we have reason to congratulate ourselves upon our collection of mammals, for though it is not large, yet practically every specimen is in the very best of condition. At present the court contains twelve large cases, two of which are given to the primates, one to the chiropteri and insectivora, one to the rodentia; three to the carnivora, four to the ungulata, and one to the marsupialia.

In the large court we have placed in the meantime all the skeletons that have been set up, and they include those of mammals, birds, reptiles and fishes. Up to the present we have not attempted a rigid classification of the mammal court for two reasons, the first being, that during the last year considerable structural alterations have been made in some of the cases, and the addition of a considerable number of new cases is at present being contemplated. The second reason is that we shortly hope to be able to transfer the skeletons of birds and fishes to the lower vertebrate gallery, thus retaining the large court for nothing but mammals.

In the lower vertebrate and invertebrate gallery a considerable amount of progress has been made with the systematic collections. Thus the birds have recently been re-arranged after the classification adopted at the British Museum. The fishes have also been recently re-arranged.

It is, perhaps, in the geological department that we have been able to make the most considerable advance, the introductions to the study of mineralogy and petrology having been almost completed, though the introduction to palæontology has not yet been started. In the introduction to mineralogy the elements of crystallography has been illustrated by a series of glass and wooden models giving the principal forms in the six systems, the most common combinations symmetry, twinning, hemihedrism, etc. In certain of the models each face has been marked with its millerian symbol, so that the student may see at a glance the relationship between the face and the axes of reference. The chemical, physical, and, optical properties of minerals have also been illustrated by models, specimens and diagrams.

In the introduction to petrology the principal rock making minerals are first given, they being arranged according to their system of crystallisation; then forty-eight type rocks are shown and described, each being accompanied by a photograph showing its microscopic structure. The remaining part of this collection is devoted to the illustration of rock structures. There are three systematic collections in the geological section—a mineral collection, rock collection, and stratigraphical collection. The first has been arranged in fifteen table cases, and is classified chemically after the method adopted in Dana's system of mineralogy. The rocks are contained in six upright cases, four of these being devoted to the igneous rocks, two to the clastic rocks, and two to the metamorphic rocks.

The stratigraphical collection has been arranged round the rooms in desk and upright cases reading from left to right, and contains a representative collection of the fossils typical of each formation from the cambrian to the post-tertiary period. Within their respective formation the fossils have been arranged zoologically, for example all the carboniferous protozoa are placed first and are succeeded in order by the carboniferous actinozoa, echinodermata, polyzoa, mollusca, and fishes.

A small collection illustrative of the geology of the Clyde Valley has been recently begun. This collection is intended to serve as an introduction to the study or the geology of the valley of the Clyde. After giving a description of the physiography of the Clyde Valley each geological formation is described in ascending order beginning with the crystalline schists of the Highlands, and then passing upwards through the Cordivician and Silurian rocks of the Southern Uplands, the later palæozoic rocks of the Midland Valley, and the boulder clay and post glacial deposits. Specimens of the rocks and fossils of each formation are shown, and diagrams and photographs are given so as to make the subject as clear as possible to the student. A number of relief models showing the physical features and geological details have also been prepared.

These include the whole or parts of the counties of Lanark, Renfrew, Ayr, Stirling and Argyll. A geological model of the Island of Arran is also in the course of preparation.

The systematic collection of minerals has been arranged in fifteen cases according to the chemical classification adopted by Dana in his system of mineralogy. The systematic collection of rocks has been arranged in eight cases, four of which are given to the igneous rocks, two to the sedimentary rocks, and two to the metamorphic rocks.

When Mr. Paton recently visited America, he was much struck with the decidedly American idea of having children's museums, a very fine one being that in the Smithsonian Institute, and when the Mansion House at Tollcross became the property of the museums committee, he suggested that it would make an admirable children's museum of natural history. This idea was very favourably looked upon by the committee, and the result is, that considerable progress has been made with the children's museum, which up to the present has proved a great success.

It will be remembered that in order to make the museum available to the public as early as possible it was opened in June 1905, with an exhibition of Scotttsh art. On the dispersal of that exhibition a beginning was made with the carrying-out of the original scheme. Cases had been for some time in preparation at Kelvingrove Gallery, in which specimens were arranged specially selected because of their interest and beauty. No attempt was made at scientific classification, the object being to direct the attention of children to natural things, and thereby arouse curiosity and encourage habits of inquiry. These cases have now been placed on view, and contain examples of (1) shells and the common objects of the seashore, (2) butterflies, moths, etc., (3) the ptarmigan in its winter and summer garb, (4) birds selected for their gorgeous plumage, (5) examples of minerals and rocks chosen for their beauty and variety of structure, and (6), most popular of all the exhibits, a case illustrating the death and burial of cock-robin, in which all the actors in the tragedy, from the assassin sparrow to the bull who tolled the funeral bell, are represented. In addition, several of the walls have been hung with coloured diagrams of the commonest trees and animals, and framed botanical specimens accompanying which are water-colour drawings of the flowers in their natural colours. Descriptive labels couched in the simplest language are appended, so that children of a very tender age may be able to read and understand them. One of the rooms is being prepared as an aquarium, in which will be placed tanks for the exhibition of both salt and fresh water creatures. In this room it is also intended to have on exhibition birds in cages and varieties of ants and bees. The complete carrying out of the scheme will take some time, but the pleasure expressed by large numbers of grown-up visitors with what has already been accomplished, and the delight of the children with the various objects, justifies the belief that the institution, so different from the conventional art gallery and museum, will prove one of the most popular of the branch museums under the management of the museums and galleries committee. I take this opportunity of acknowledging my indebtedness to Miss M. Craven, Keighley, for her great kindness in writing the labels for the botanical section, and for many helpful suggestions regarding the other collections in the children's museum.

I now come to the concluding and perhaps the most important part of my paper, namely, the lines along which the future development of the collections should take place. From the scheme that has already been submitted to you, you will have seen that we are aiming at something more than a merely provincial collection, and considering the importance of our city, I think that we are fully justified in doing so. What we have achieved in our other departments, and more especially in our art collections, ought to incite us to do something more for the natural history department, so that the one should not cast a reflection upon the other, but that all should be equally and proportionally developed. I venture to think that the question of the specialisation of our museums is one that will have to be faced in the near future. The art collections are increasing so rapidly at Kelvingrove that perhaps the time is not so very distant when the whole of that building will be required for art alone, and then we shall have to consider the housing of the other collections elsewhere, which will probably mean the erection of a building equal to, if not larger, than the present galleries, but less ornate, and specially designed for museum purposes.

Let me make it clear to you, however, that in my present paper I have no intention of discussing anything just quite so far ahead. The City of Glasgow has done so splendidly for its museums and art galleries within the last ten years that I think it deserves a little rest.

What I now come to speak about is what ought to be done at once, or soon as possible. First of all then, as regards the introductory and systematic collections of mineralogy, geology, botany and zoology, I should like to see these considerably developed and strengthened by the adding of additional types, and by the procuring of the very best materials in the way of models, diagrams and dissections, that can be obtained. For instance, if we had a set of the blas models, they would be of invaluable use in the introduction to the study of zoology. Again, I do not see why the present introduction to the study of mineralogy should not have the section dealing with the optical properties of minerals further developed by the addition of a set of models to illustrate the position of the optic axes and axes of elasticity in a number of typical minerals.

As regards the botanical section, this has not yet been touched, as no room could be found in the present building for its proper arrangement. We have, however, a large amount of material that could be used in this section, and with the purchase of some of Brendel's models, an educative and interesting introduction to the study of botany could be laid out.

In the systematic collections there are many blanks which can only be filled from time to time as the specimens are procured, and every opportunity of acquiring such specimens is eagerly taken advantage of, so that in a short time we may hope to have a fairly good collection.

A very great deal of work can, of course, be done with the space that is available at the present moment, and I will now briefly indicate the developments that are actually in progress. It is hoped that when the cases of the court have been completed, that it will then be entirely devoted to the collection of mammals and the introduction to the study of zoology, the mammals that are at present in the pavilion containing the extinct animals being transferred to the court.

The bird skeletons in the court, and the bird and reptile specimens in the pavilion, will then be transferred to the gallery containing the lower vertebrates and invertebrates, and the pavilion at present devoted to the extinct animals will be converted into a botanical room.

If this arrangement were carried out, it would give a fairly symmetrical and proportionate development to the natural history collections, the large court being devoted to the mammals, and the introduction to the study of zoology; one of the long galleries to the lower vertebrates and invertebrates, the other long gallery to the geological collections, a pavilion to botany, and a pavilion to the British natural history. All this could be done with the space at present set aside for the natural history collections. There, however, still remains one great disadvantage, and that is that no allowance is made for the development of what is, after all, our most important collection, namely, the British collection.

If it could be found possible to devote the whole of one side of the Museum to natural history, the difficulty could be solved by transferring the British collection into what is at present the ethnographical gallery, and devoting the pavilion, at present occupied by the British collection, to mineralogy. This would involve a considerable rearrangement of the collections, but it would be well worth the trouble, and would, I venture to think, make a fairly complete and symmetrically developed natural history collection.

According to this arrangement, the present stratigraphical method adopted for the fossils would be abandoned, and a zoological classification adopted. It would then give the large court to mammals, recent and extinct: a large gallery to birds, reptiles, and fishes, recent and extinct, and a long gallery to the invertebrates recent and extinct, one pavilion would be devoted to botany, and the other to mineralogy and petrology, with, perhaps, a small stratigraphical collection, while the long east gallery would be set aside for the British collection.

Of course, it will be asked what is to be done with the ethnographical collection, if the whole of one side of the Museum is to be devoted to natural history, and in reply to this question, I may remind you that in a few years the old Kelvingrove Museum will be vacated by the Jeffrey Library, and will again be available for museum purposes. I would suggest, then, that some of the smaller departments which are not likely ever to require the same space as the natural history collections, be removed to that building, for which purpose it might be specially set apart.

In conclusion, I should like to urge the great desirability of using every means for the acquiring of such natural history collections as yet remain in the West of Scotland. I cannot here refer to these collections in detail, as most of them are in the possession of private individuals, whose desires regarding the ultimate destination of these are not known. There still remain quite a number of important collections in the West of Scotland, and I refer more especially to the palæontological and geological ones, some of which contain specimens which are known all over the world, and which are absolutely unique. In the other branches of natural history, Glasgow has many scientific and zealous collectors, and I strongly urge that every effort be made to find for those collections a resting-place in Kelvingrove, so that we shall not require to blush for very shame when our children ask us where they have gone.

A Demonstration of Vibrating Plates and Bars.

By CHARLES R. GIBSON.

[Read before the Society, on 21st November, 1906.]

WHEN the request was made to me that I should show you those vibrating plates, I thought, at first, that the experiment of *Goold's Crawling Chains* was the only one worthy of special demonstration, that experiment not being well known. But I have found so many friends interested in this large Chladni plate, that I propose showing you a few of its sand-figures.

Many of you are quite familiar with the ordinary form of Chladni plate, which has been known for more than a century. It consists of a square piece of metal or glass fixed at its centre to the top of an upright pillar. When the surface of the plate is sprinkled over with dry sand, and a violin bow is drawn across the edge of the plate, certain well-known sand-figures are produced.

Here we have a much heavier plate (Fig. 1), weighing about 15 lbs., and instead of being permanently fixed at its centre, it is merely supported upon four small rubber rests, the positions of which may be altered at will.

My first experiment is to explain the method of producing the vibrations in the plates. Here we have four short bars of steel (Fig. 3), supported upon little pieces of rubber at their nodes, and standing over the open top of a resonance box. The fundamental notes or frequencies of these bars are 400, 500, 600, and 800 vibrations per second, respectively. If I strike the bars at their centres they give forth their fundamental notes, but the vibrations are weak and short-lived. Here I have a vibrator—or, rather, a series of four "vibrators"—set in one handle for convenience. Each of these vibrators consists of a short piece of steel wire furnished with a leather tip, similar to that of a billiard cue. These vibrators have been set or tuned to the four fundamental frequencies of the bars—400, 500, 600, and 800 vibrations per second, respectively. If I now draw those vibrators in succession over the bars with which they have been synchronised, you should hear clear musical sounds corresponding to the rates of vibration which I have just mentioned. This method of synchronising the vibrators was first used by Joseph Goold, of Nottingham.

This, then, is the method of vibrating the heavy Chladni plate. A vibrator is set to give any desired number of vibrations per second, this being arrived at by careful experiment. The vibrator is then gently drawn across the plate—as shown in Fig. 1. The plate is rapidly thrown into a vigorous state of vibration, singing out the musical note corresponding with the rate of vibration produced, and at the same time producing one of Chladni's sand-figures, as shown at Fig. 2.

Those of you who are not familiar with the phenomena of vibrating plates may not see, at once, how the figure is produced. As some laymen have difficulty in realising, in such cases as this, that waves with their crests, troughs, and nodes, are realities, I would suggest the following brief explanation. Imagine each molecule of steel of which the plate is composed to be vibrating at say 1200 vibrations per second. Then picture the molecules in one section of the plate to be out of step with the molecules composing the neighbouring section, so that as the one set of molecules is moving upwards the other set is moving downwards. There will be a consequent over-lapping of these two neighbouring sections, so that at their junction we may picture the one set of molecules neutralising the motion of the second set, producing thereby a state of rest along the junction, or, in other words, a nodal line or curve. When the plate is covered with sand and then caused to vibrate, the sand will be driven along to those lines of rest.

It may be remarked in passing that it is found convenient to make some of the vibrators from short pieces of cane with leather tips (Fig. 3). In all cases the vibrators must be firmly fixed in suitable handles. The larger the amplitude of vibration, the greater must the mass of the handle be. It will be apparent that the handle must not form part of the vibrator proper, but must merely act as a suitable support.

One finds that it is necessary to use greater care in setting the vibrators for the lower rates of vibration—say, about 100 per second—than in setting for a pitch of 1000 vibrations per second. Indeed, the vibrators for higher pitches may be used for several different rates of vibration without altering the length of the vibrator. I am able to show you three different figures by means of this one vibrator as it is now set. These three figures represent the following rates of vibrations in this plate—1060, 1125, and 1200 vibrations per second. (Only the figure for 1200 is illustrated, Fig. 2).

While I speak of these particular figures as representing certain definite rates of vibration, it will be understood that the frequencies mentioned have reference only to this particular plate, or to another exactly similar one. The same figures may be produced in other plates at quite different rates of vibration. While the figures themselves are well-known, they have no particular rates of vibration attached to them, such as the recognisable ratios in connection with harmonograph figures.

In using this form of Chladni plate, it is, of course, necessary to place the node rests at points where the plate will not be vibrating. It may be well to remark, however, that the positions of these node-rests in no way determines the positions of the nodal lines of the figures. That might be demonstrated by means of this long bar (Fig. 4), but at present I have it set for the crawling chain experiment, and, indeed, the demonstration would be so simple that it hardly calls for a performance. To take the simplest case of vibration, and cause the long bar to vibrate between the two node-rests as a violin string vibrates between the bridge and finger-board, we would find the sand gather in two simple straight lines across the bar—one line over each of the node-rests. If we were then to alter the position of the node-rests and repeat the experiment, we should find the lines to again appear in exactly the same positions as before, ignoring the false positions of the node-rests. The plate will, of course, vibrate more freely when the node-rests are in their true positions.

I now show you the crawling chain experiment, and I need hardly remark that the phenomenon is entirely due to the vibrations of the bar. A vibrator is arranged for this experiment to give about 700 vibrations per second, and you will notice (Fig. 4) that I draw this vibrator along the cut-edge instead of along the flat top of the bar. As soon as the bar is thrown into a state of vibration you see the watch-chains crawl along the bar in opposite directions to each other, and completely coil themselves up in snake like fashion over the nodes.

If I sprinkle sand upon the bar and cause it to vibrate again, in the same manner as for the crawling chain experiment, we shall see more clearly what is taking place in the vibrating bar. We find (Fig. 5) that while there is a short nodal line formed diagonally at each end of the bar, and a nodal curve along the centre, there is a continuous vortex movement of the sand over the nodes. As long as the bar is kept vibrating there is this continual circular procession of the sand over the nodes, while the sand forming the nodal lines and curve has no forward movement. This vortex phenomenon was discovered by Goold, of Nottingham, some ten or twelve years ago.

You will observe that there are four small metal clamps affixed to the bar near its corners. The function of these clamps will be best understood by removing them and examining the consequent change in the resulting sand-figure. You will observe (Fig. 6) that the vortices still remain, when I repeat the experiment without the clamps, so that these vortices are an inherent property of the vibrating bar. Vortices are not found in every bar of steel; it took Goold more than one trip from Nottingham to Sheffield to procure this bar.

From the sand-figure upon the unclamped bar (Fig. 6) you will further observe that the nodal curve along the centre has disappeared. If I now put the chains upon the unclamped bar, and set it vibrating as before, the chains do not crawl along, but are merely thrown off the bar. It is clear, therefore, that while the vortices give the forward motion to the chains it is necessary that they have a line of rest, or nodal curve, along which they may be drawn.

The function of the clamps may be demonstrated in another way, which will, perhaps, help to make the matter clearer. If I treat the bar as a Chladni plate, drawing the vibrator along the flat top of the bar (Fig. 7) we get a simple figure showing one straight line along the centre of the bar, lengthwise, and two short nodal lines at right angles to this, across the bar. It will be observed that these are not immediately over the node-rests, the rests having been left in the same positions as for the previous experiments. I remark upon this as it may serve to demonstrate the point already referred to—the position of the node-rests in no way determines the positions of the nodal lines. While the same vibrator has been used for this as for the previous experiments, it will be observed from the sound that the rate of vibration is somewhat higher when the bar is bowed upon the top, the resulting rate of vibration being about 750, as against 700 per second when bowed upon the edge.

Proceedings of the Royal Philosophical Society of Glasgow, 1906-1907. *Vol. XXXVIII. PLATE V.*

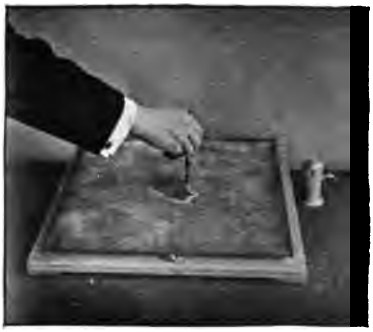


Fig. 1.

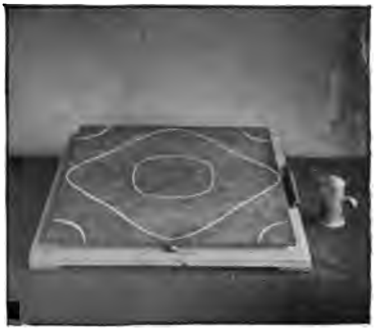


Fig. 2.

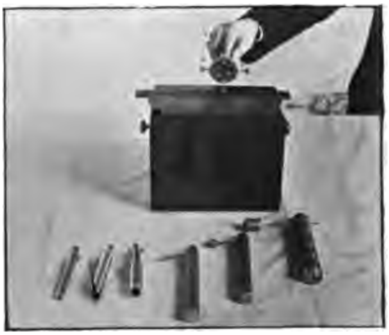


Fig. 3

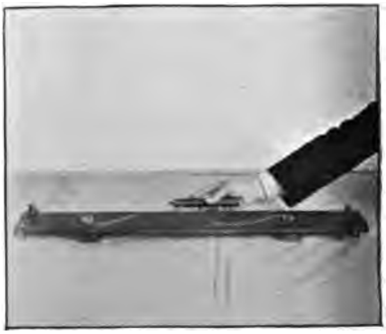


Fig. 4.

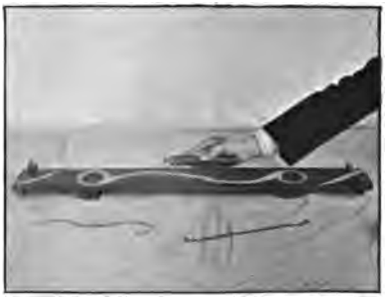


Fig. 5.

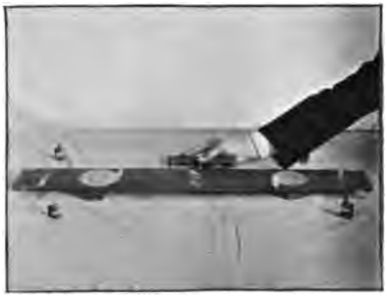


Fig. 6.

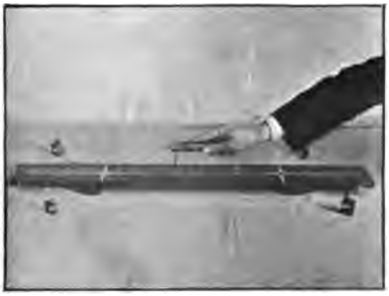


Fig. 7.

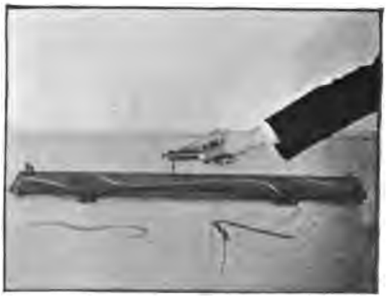


Fig. 8.

If I now replace the clamps, taking care to put each in its proper place, as they vary in weight, and I again bow the plate upon the top (Fig. 8), you will observe that the clamps have distorted the previous sand-figure. The central part of the long nodal line and the two cross lines have been twisted into a curve, while the ends of the long line now lie in a diagonal position. The direction of these diagonals and of the nodal curve may be reversed by altering the position of the clamps, the heavy clamps being placed in the former position of the light ones, and *vice versa.*

As far as the crawling chain experiment is concerned, we have seen that these clamps merely throw a nodal curve between the vortices, providing a path of rest along which the chains may be drawn by the motion of the vortices. Before any forward motion of a chain takes place its end must be within the area of the moving vortex.

Mr. Goold informs me that he has found a bar with four vortices, and these travelling in different directions to each other.

The phenomenon of these vortices has not been entirely explained. The best that has been said is that the phenomenon is due to the simultaneous action of two sets of vibrations acting at right angles to each other, and to some definite ratio between these two sets of vibrations. I therefore commend the problem to the physicists of the Society, to some of whom the phenomenon may be new.

Note.—During the demonstration I frequently used the word *generators* as descriptive of the vibrators, but I find that this word gave rise, in the minds of some members, to a supposed electrical effect. I have, therefore, deleted this word from the paper, although it is a common expression in connection with these vibrating plates.

The Limiting Speed of Vehicles moving on Curves, and the Effect of the Gyrostatic Action of the Wheels on Stability. By Professor ANDREW GRAY, LL.D., F.R.S.

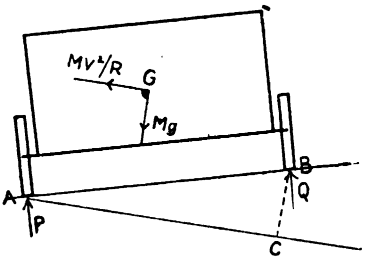
[Read before the Society, Wednesday, 5th December, 1906.]

THE recent terrible accident at Salisbury Station in which twenty passengers of an express train were killed through the capsizing of the locomotive, directed attention to the question of the stability of vehicles on curves. For there can be no doubt that the accident was caused by taking the curve at too high a speed; the locomotive simply fell over on its side on the outside of the track. The accident at Grantham also, though that has not yet, so far as I know, been fully explained, was probably due to a similar cause. In that case, derailment took place after the curve beyond the station had been passed; but possibly oscillations were set up on the curve which produced disastrous effects a little further on where the super-elevation had ceased.

The frequency of accidents through the skidding of motor cars when turning corners, or when suddenly changing the direction of running is only to be explained by an insufficient appreciation, on the part of those in charge, of the conditions of stability of vehicles when turning. In my opinion, corners are habitually turned far too quickly by motor-cars for the safety not only of the public, but of the persons in the cars. It ought to be remembered that people of different ages and of very different degrees of activity and presence of mind are continually crossing, and are entitled to cross in safety, at such places; and likewise that ordinary streets and roads are not sloped, as a specially constructed track always is, inward towards the centre of the curve, so as to diminish the tendency to capsize outwards, which always arises when the vehicle is taking a curve.

The dynamical theory of this matter, so long as the gyrostatic action of the wheels and other rotating parts is not taken account of, is very simple. It has been dealt with recently in an article in the Engineering Supplement of the *Times*, and by another writer in *Nature*. I have thought that perhaps a short rediscussion of the subject, so as to include a determination of the gyrostatic effect of the wheels of the locomotive, an effect which has been referred to by various people as probably an important factor, would not be altogether needless at the present time. And I have been very materially assisted by drawings and numerical data for express engines built by Messrs. Dubs & Co., which I owe to the kindness of Mr. William Lorimer of that firm.

In order to put down the theory, suppose that in the figure AB represents the position of a cross-section of the wheel-base of the vehicle, so that BC is the super elevation h of the track of the wheels on one side, the outer, let us say, above the track on the other side; that G, the centre of gravity of the vehicle is at a distance d from the wheel base, that $2b$ is the distance from the centre of one track to the centre of the other, and that θ is the angle BAC. We shall suppose that P and Q are the reactions of the rails (or ground) on the two sets of wheels, as indicated on the figure, and that V is the speed of the vehicle, R, the radius of the curve, say the radius of a line midway between the two tracks, and Mg the weight of the vehicle. We have by the diagram, taking moments first about B, then about A, for the two forces P, Q, and weight Mg, and equating the sum of moments about the same point, of the rate of change of momemtum MV^2/R (which is directed inward from G towards the centre of the curve) we get



$$2bP = M\left\{g(b\cos\theta + d\sin\theta) - (d\cos\theta - \tfrac{1}{2}h)\frac{V^2}{R}\right\}$$

$$2bQ = M\left\{g(b\cos\theta - d\sin\theta) + (d\cos\theta + \tfrac{1}{2}h)\frac{V^2}{R}\right\}$$

But $\cos\theta = \sqrt{4b^2 - h^2}/2b$, $\sin\theta = h/2b$, and therefore the equations just written become

$$4bP = \frac{M}{Rb}\left\{gR(b\sqrt{4b^2 - h^2} + hd) - (d\sqrt{4b^2 - h^2} - hb)V^2\right\}$$

$$4bQ = \frac{M}{Rb}\left\{gR(b\sqrt{4b^2 - h^2} - hd) + (d\sqrt{4b^2 - h^2} + hb)V^2\right\}$$

From these expressions the force on the rail or the ground exerted by the wheels on either side can be found. Also, by putting P equal to zero, we can find the value of V for which the inner wheels just cease to press on the rail or ground.

The following are approximately the forces for a locomotive similar to that of the Salisbury accident. For that engine the distance $2b$ was 59 inches; the height of the centre of gravity above the wheel base was also 59 inches, nearly; the weight of the engine was 52·2 tons with water in the tubes and men on the footplate. The radius of the curve at Salisbury was 528 feet, and the super-elevation of the outer rail 3·5 inches. The following table gives the forces on the rails of this curve for the speeds mentioned:—

Speed	Inner Rail	Outer Rail
30 Miles per Hour.	23·9 Tons.	29·3 Tons.
40	19·3	33·9
50	13·4	39·8
60	6·2	47
67·3	0	53·2

The super-elevation of the outer rail, which would just give zero force on the inner rail for different speeds, are shown in the second table:—

Speed	Super-elevation
15 Miles per Hour.	− 27 Inches.
30	− 21 inches.
40	− 17 inches.
50	− 9·3 inches.
60	− 2 inches.
67·3	+ 3·5 inches.
70	+ 5·2 inches.
80	+ 14 inches.

Of course, when there is zero force on the inner rail the state is one of extreme danger, and the speed should fall far short of that which throws all the weight on the outer rail. The speed of 30 miles an hour, at which there are five parts of the weight on the outer rail and four parts on the inner, is probably high enough. For it is to be remembered that transverse oscillations of the engine are inevitably set up which produce alternate increase and diminution of the weight on either rail, and that if the speed is so very high as to even approach the critical value (that which makes the force on the inner rail zero) the equilibrium will be endangered by every oscillation set up. And if it happen that a considerable oscillation, set up by any cause, is so timed as to chance to be assisted by some other disturbance, the equilibrium may be destroyed, and capsizing or derailment take place.

It will be observed that I have not discussed the effect of the parallelism of the axles of the driving and trailing wheels, which renders pure rolling of the wheels on both sides impossible. The engine has no differential gearing like that provided in a motor car; and, besides, in the case of a six-coupled locomotive the differential wheels overlap the rails to different extents. All these things must conduce to the production of oscillations, which might be a source of serious danger at speeds even considerably below the critical speed.

I may say here that there can be no doubt that the contention always put forward in letters to the newspapers when a locomotive is derailed on a curve, that the flanges on the wheels are not sufficiently deep, is without real force in almost any case. It is true that with increase of size and weight of locomotives the depth of the flange has not increased; but no flange, however deep, could be of the slightest use in preventing the inner wheel of the locomotive from leaving the rail on a curve.

For motor-cars I have not yet been able to obtain exact data. But we may take the height of the centre of gravity, perhaps, as 24 inches, and the breadth of the wheel base as 5 feet. The critical speed for turning a corner of a street 30 feet wide and level (that is in a curve of 15 feet radius), is about 24 feet per second, or 16 miles an hour. For, from the equation for P given above we have, since $\theta = 0$ and $h = 0$, and P is to be made zero,

$$V^2 = gR\frac{b}{d}$$

Here b is 30 inches, and we get

$$V^2 = 32 \times 15\frac{30}{24}$$

or

$$V = \sqrt{600} = 24{\cdot}5$$

in feet per second.

The inward pull of the ground on the wheel tyres necessary to give the centreward acceleration V^2/R is MV^2/R, and this is furnished and communicated so as to overcome the inertia of the car, by the grip of the tyres on the ground, and their stiffness and the security of the fastenings to the wheels. The ground pulls the tyres inwards, the tyres pull out on the ground. If the inertia of the car be great, and the ground through its smoothness or its slipperiness, in consequence of wetness or muddiness of the surface, cannot obtain sufficient grip of the tyres, the wheels will skid. It is to be noticed that the force MV^2/R on which skidding depends, is proportional to the second power of V. It is desirable, therefore, from the point of view of skidding alone, to drive slowly when turning a corner.

With regard to the gyrostatic action of the wheels, it may merely be stated that the capsizing torque on the carriage or locomotive brought into play by this cause, is $\mu\omega\phi$, where μ is the total moment of inertia of the wheels about their axes, ω the angular velocity of their rotation, and ϕ the angular velocity with which the carriage is moving round the curve. If r be the radius of a wheel, and R the radius of the curve

$$\omega = \frac{V}{r}, \quad \phi = \frac{V}{R}$$

so that the torque is $\mu V^2/Rr$.

For the locomotive which capsized at Salisbury, the total moment of inertia of the driving and trailing wheels may be estimated as 34, taking a ton as the unit of mass, and a foot as the unit of length. Thus we obtain for the torque approximately the value $34 V^2/3{\cdot}35 \times 528$. For 60 miles an hour V is 88 feet per second, and thus we obtain for the torque, in the units indicated, $34 \times 7744/3{\cdot}35 \times 528$.

We must take account of this in the equation of equilibrium. Denoting the torque $\mu V^2/rR$ by L, the equation for $2bP$, given above (p. 4) is at once modified to the proper extent by subtracting L from the right hand side. The final result when L is taken into account is

$$V^2 = 32 \times 528 \frac{33}{57{\cdot}25 + 2{\cdot}25}$$

as against

$$V^2 = 32 \times 528 \frac{33}{57{\cdot}25}$$

This is a diminution of about 4 per cent. on V^2 or 2 per cent. on

V. The critical speed is thus only diminished from about 67·5 miles an hour for the Salisbury curve to 66 miles an hour. The gyrostatic capsizing action is, therefore, comparatively trifling in amount, and need hardly be reckoned with, when a proper margin of speed safety is maintained. It is to be noted, however, that it diminishes the safety.

The smallness of the effect renders it unnecessary to calculate the moment of inertia of the wheels more exactly than was done for the estimate given above, which is very rough.

I have not yet obtained information as to the moments of inertia of the wheels of motor-cars. These moments are easily obtained experimentally by hanging the wheel horizontally by three cords attached symmetrically about the centre, and determining the period of oscillation about the axis, first, when the wheel alone is used; second, when a uniform bar of known dimensions and mass is laid along a diameter with its centre at the centre of the wheel. Let the moment of inertia μ' of the bar about a vertical axis through its centre, as it lies on the wheel, be calculated, and let T, T_1 be the period, of oscillation without and with the bar. Then

$$\mu = \frac{T^2}{T_1^2 - T^2}\mu'$$

so that μ can be found from μ' by observation of the two periods.

Vision and Work. By FREELAND FERGUS, M.D., F.R.S.E., Hon. Secretary of the Society.

[Read before the Society, 13th March, 1907.]

SIGHT is generally stated to be one of the five senses; the others being hearing, tasting, touching, and smelling, but a moment's reflection suffices to show what is well recognised by all physiologists, that the sense of sight is complex. It is a sense which responds only to very short vibrations in the luminiferous ether, and, if we exclude radio active emanations, such as the Rontgen rays, cannot be excited in any other known way. It conveys to us information as regards first, the form of objects; second, the colour of objects; third, the shade of objects; fourth, the positions which they occupy in space relatively to each other; fifth, it is the factor which helps us to determine the apparent size of objects. The functions which concern us in the present communication are the first, third, and fourth.

The Form Sense is usually and very conveniently measured by test types. The types commonly employed in this country are those which we owe to Professor Snellen, of Utrecht and so long as they are regarded merely as a comparative test, and not as an absolute standard, they serve the purpose admirably.

To the form sense the term Visual Acuteness is commonly and we venture to think, somewhat erroneously applied. This function of vision is strictly limited in extent to that part of the field of vision which is associated with the macula lutea. The truth of this observation is easily proved by looking at an ordinary line of print. If the observer fixes his eye on a word about the centre of a line of printing, he will find, that so long as he fixes his eye on the word selected, he is quite unable to distinguish the words on either side of it. Or again, if the observer looks steadily at one of the lines of Snellen's types, he will observe that so long as he concentrates his fixation on one of the letters, he is quite unable to see the others in the same line. This is specially true for those lines which contain the smallest characters. If one of the two letters which should be seen at 36 metres by a healthy eye is steadily fixed, most people, although not all, will be able to form some idea of the other one. This they do probably by their light sense and not by their visual acuteness. Visual acuteness, properly so called, occupies a space in the field of vision represented approximately by a cone, the apex of which is at the first nodal point, and which has an angle of about forty minutes.

The whole field of vision for each individual eye in health extends in the horizontal direction to about 160 degrees, and in the vertical direction to about 140; from which it is obvious, that the form sense, if taken as synonymous with the visual acuteness, concerns an extremely small portion of the field of vision. This limitation of the visual acuteness, as is well known, corresponds with an anatomical peculiarity in the eye. It depends upon the fact that that portion of the retina, which is known as the macula, has special end organs which, no doubt, are associated with a person's power of reading or writing. A very short way from the macula the retina possesses no visual acuteness at all in the proper sense of the term, although here it posseses the power of distinguishing colours, of differentiating gradations of shade, and of perceiving movement. Thus, if I look at a point on a wall a considerable number of feet below a picture frame, I can tell quite well that the picture frame is round, oval, oblong, or square as the case may be. I have a perfect idea of its form, and even of its size, although I am quite unable to see any of the details of the picture. Such perceptions of form are probably a function of the light sense or of the power of distinguishing shades, but they suffice to show that the usually accepted view that the form sense and visual acuteness are synonymous requires to be modified.

The question naturally arises, what functions of vision are necessary to enable a man to work? The answer to that is: it depends entirely upon the nature of the work. A man would require good visual acuteness to be a clerk, or a watchmaker, or a typewriter. There are many occupations where visual acuteness, in this restricted sense, is necessary; but, on the other hand, there are many forms of occupation, especially labouring, which seem to require almost no visual acuteness, but demand three things: first, the light or shade sense; second, the rough ideas of the form sense obtained from the light sense; and third, the sense of alignment. Given these, a man can do almost any kind of labouring work, and hence, we regard it entirely as a mistake to attempt to express a man's earning capacity in terms of his visual acuteness. It appears to us to be an erroneous method of estimation.

A simple experiment will serve to illustrate the truth of the views here enunciated. Let a small coin be placed on the table to either side of the observer at such a distance to his side that the image of the coin is not formed on that part of the retina with which the person reads, but on a part more towards the periphery. Two things are found to be true. In the first place, the person who is making the experiment is aware of the form of the object; he sees that it is round. In the second place, he will experience no difficulty whatever in raising his fist and striking the object every time he makes the attempt. To take a concrete example, I put a small piece of paper on the table in front of me, and I look steadily at it with my right eye while I close my left. I then take a coin and put it to the right hand side of the fixation object, and I approximately make the distance of the coin from the fixation object the same as that between my eye and the paper; so that the angle between the axis of vision and the line joining the first nodal point of my eye with the coin will be approximately 45 degrees.

Yet, I am conscious of the round form of the object which lies away to the side of the fixation point and, although I keep steadily looking at that fixation point, I have no difficulty whatever in raising my fist and coming down on the top of the coin.

Indeed, if I desire, I can strike it every time with the point of any one of my fingers. The striking of an object then, even lying to the side in the manner that this coin has done, depends not in the least on binocular vision nor on visual acuteness, but on what here may well be called, for the sake of convenience, the sense of alignment. Further, it is to be observed that for this sense of alignment visual acuteness, in the restricted sense of the term, is not required. It would be quite impossible for me to read any characters with that part of the retina on which the image of the coin is made. All that is required is that the light sense is sufficient. We thus come to an important conclusion, namely, that most forms of work can be done with one eye. Nature has endowed us with two eyes so as to give us the intuitive sense of the third dimension, but two eyes are not required, at any rate, for most forms of work.

The periphery of the retina is especially adapted for the perception of movement. Thus, if a person with a healthy eye look straight in front of him, and hold up his right hand so that the angle between the line of vision and the line joining the fingers of the hand with the eye is approximately 90°, and if the fingers of the hand be made to move, the person is at once conscious of the slightest movement; not only so, but by his light sense and by his power of distinguishing movement, he is able to locate the object perfectly well in space, at any rate so far as its alignment is concerned. Thus, we see that for the work of a labourer visual acuteness is not required, but only this sense of alignment which depends upon those stimulations of the retina which are more particularly associated with the light sense.

One other observation falls to be made. The sense of alignment is all that is required for the employment of the larger tools. Again and again I have found persons who are possessed of only one eye quite able to use a hammer, or to wheel a barrow, or to handle a spade, or pick, or shovel, and any one who tries it will find that he experiences no difficulty whatever in performing any of these manipulations with one eye shut. The reason of this is perfectly obvious; in all these forms of labouring the important matter is not the relative distances of various objects to each other, but it is the alignment, and the absolute distance of the object from the person who is engaged in the work.

One other remark may be made in conclusion. In an earlier part of this communication it was stated that the visual acuteness is a function of that part of the retina which is known as the macula lutea. There are good grounds for believing that it is also a function of certain definite centres in the cerebral cortex. If a young child, say between the ages of 1 and 3, begins to squint with one eye, then if that squint is allowed to remain for any length of time, the visual acuteness undergoes serious and permanent deterioration; probably it does so within a period of two months from the onset of the squint. Now, if later in life the eye becomes straight it is found that good visual acuteness, as tested by Snellen's scale, is not regained, the visual acuteness may improve a little, but only very slightly, although the patient will have that perception of form which depends upon the light sense. The explanation of this circumstance, which seems most probably true, is, that in the early years of life the cerebral cortex becomes differentiated according to the function which it is afterwards to subserve. From the squinting eye no stimuli suitable for the development of the visual acuteness are received, and consequently the cortical centres connected with that eye never have proper visual acuteness. On the other hand, if the squint takes place subsequently to the development of the cortical centres, say, after the child is six years of age, then it is generally found that the squinting eye, as well as the other one, has good visual acuteness.

If a patient who has this amblyopia or defective visual acuteness from squint loses by accident his good eye, it is generally found that although the visual acuteness in his remaining one does not materially improve, yet he has, as a rule, no difficulty in performing any kind of labour. The speculations which such observations awaken are of great interest. It would almost seem that during the first years of life, it is the mind that arranges the brain and not the brain the mind. They also throw considerable doubt on the theory that the macular area of each eye is represented on each side of the cortex.

River Pollution and River Purification in Scotland. By JOHN GLAISTER, M.D., D.P.H.(Camb.), F.C.S., F.R.S.(Edin.), etc., Professor of Medical Jurisprudence and Public Health, University of Glasgow.

[Read before the Society, 13th March, 1907.]

DURING the session of 1896-97, while president of the Sanitary and Social Economy Section of this Society, I took as the subject of my address the "Pollution of Scottish Rivers," for a full account of which I must refer those interested to the Transactions of the Society. But in order to give continuity between what was said on that occasion and what has to be said on this, it will be necessary to briefly recapitulate certain points therein discussed, in order that more easy comparison may be made between the condition of matters referable to river pollution then and the condition which obtains now.

In the first place, it was pointed out that enquiry into the state of the rivers of this country had its origin in the Government of the day, who appointed a Commission in 1868 to "Inquire into the best means of preventing the pollution of rivers;" that, in consequence of the reports of that Commission, the Rivers Pollution Prevention Act, 1876 (39 and 40 Vict., cap. 75) was passed, and later, because of the difficulty which arose in the interpretation of Section 3 of that Act, the "Act to explain Section 3 of the Rivers Pollution Prevention Act, 1876" of 1893. It was further shown that, although twenty-one years had elapsed since the passing of the principal Act, practically its provisions, so far as Scotland was concerned, were a dead letter, and that the rivers and streams of Scotland, which the Commissioners found to be polluted, were still as bad, if not, indeed, worse than they were at the passing of the Act. Further, that the varied forms of pollution instead of diminishing in number and character had steadily increased in both directions, and that at least one comparatively new form, although known to the Commissioners, had since become an increasing and a fruitful source of offensiveness and pollution. Regarding the provisions of the Act of 1876, no detailed consideration will now be given, as they were fully discussed on the previous occasion, except to say that the substances which, put into rivers, would come within the terms of the Act, are divisible into three classes, viz. :—(*a*) Solid matters from trade processes or from any other source; (*b*) Sewage pollution, liquid or solid; and (*c*) Poisonous, noxious, or polluting liquids from any trade process, or poisonous, etc., solids or liquids from mines, other than water in the same condition as that in which it has been drained or raised from a mine.

The Act of 1893 may at this stage be got rid of in our consideration of the subject by quoting section 1 thereof, which is interpretative of section 3 of the original Act. It runs as follows:—

"Where any sewage matter falls or flows or is carried into any stream after passing through or along a channel which is vested in a sanitary authority, the sanitary authority shall, for the purposes of section 3 of the Rivers Pollution Prevention Act, 1876, be deemed to knowingly permit the sewage matter so to fall, flow, or be carried."

Since 1893, nothing further in the way of legislation of a general application has been enacted by Parliament on the subject. In my address, it was further pointed out in some detail, after inquiry, what were the conditions of the rivers in most of the counties of Scotland. In short, the conclusion was arrived at, both from the permissive character of the Act itself, and from the cumbrous machinery therein provided, even when proposed to be set in operation, that present statute legislation was ill-calculated to produce restoration to purity of our streams, although by no means prohibitive of good results if steadily and patiently pursued.

In the present paper, I propose to consider what progress has been made by those whose function it is to administer these Pollution Acts, and to deal in some detail with some characteristic cases of river pollution which have been brought before the courts, and with the lines of evidence upon which the existence of pollution has been based; and last of all, to discuss what measures must in the near future have to be taken by the Local Authority of this city with regard to the pollution of the Clyde, so that the large sums of money which have been spent in the purification of the river may not have been spent in vain, and their beneficent schemes rendered nugatory.

Progress in Purification of Rivers made by County Councils.— It is gratifying to report that since 1897 certain County Councils have shown commendable activity in this direction, while, on the other hand, others have remained absolutely supine. The County Council of Lanark must be placed in the forefront of the former, and their work in this direction deserves and demands some detailed consideration. In 1897, I ventured to sum up the condition of the Clyde in the following terms:—"The Clyde about 90 miles in length from its source to the sea, drains about half a million acres of land, and before it arrives at Glasgow receives the daily sewage of about 350,000 people, the coal-washings of about thirty collieries, the refuse of paper-mills, gas-works, mills—paper and others—calico printing works, dyeworks, and of half a dozen sulphate of ammonia works. It is little wonder, then, that even before it reaches this city, its waters become gradually more filthy as we approach the city, and the filthiness attains its maximum before it reaches Bowling."

Since then, however, very remarkable progress has been made by the County Council of Lanark and the City of Glasgow to restore the purity of the streams, and especially of the Clyde, within their jurisdiction.

The County Council, in October 1905, at the instance of a report by its Public Health Committee, determined that the Council itself should undertake the enforcement of the Rivers Pollution Act, the advantage of this course being that the Council itself was not concerned with the management of special drainage districts, which are under the direction and control of District Committees, and could not, therefore, itself be an offender against the Acts. This step it took in virtue of the Local Government (Scotland) Act, 1889, section 55 (1) which enacts that a County Council shall have power, in addition to any other authority, to enforce the provisions of the Rivers Pollutions Acts. In consequence, the whole policy of enforcement of purity of streams within its jurisdiction has been controlled and directed by the Council, and not by the District Committees. To my mind this policy is of the highest wisdom, inasmuch as it constituted one authority for every watershed within the jurisdiction. Up till the middle of 1900, this work was carried on by the ordinary sanitary staff, but in that month (July) two additional inspectors were appointed whose duties were confined to Rivers Pollution Prevention and the work of the Sale of Food and Drugs Acts. By the end of the year 1902, two years later, no fewer than 1420 inspections were made, 1366 samples were taken, and 432 pollutions were detected from 288 sources of trade processes liable to cause pollution, and during the same period 187 inspections were made and 304 samples taken referable to sewage pollutions. These figures of themselves indicate with what vigour the work was being prosecuted. The work of analysis had grown so large that the Council found it necessary in April 1902 to appoint a chemist who should devote his whole time to the work of the Council.

The plan of campaign was also well laid down. In order to abate pollution from sewage, the Council, in September 1896, called a conference with all the local authorities, Burgh Commissioners, Town Councils, and District Committees, who were polluters, to consider the future steps to be taken. It was pointed out at the conference that these authorities were polluting the Clyde and its tributaries with the sewage of 127,000 persons, and that it was necessary that proceedings should be taken by them without unnecessary delay to remedy this, but that they themselves must initiate and carry through the remedial measures. To avoid litigation, notwithstanding the evidence of unwillingness on the part of many of these authorities to comply with the requirements of the Council, the administrators of the Acts, the Council, permitted two years to elapse before any legal proceedings were taken. But they were compelled to take such steps against the Burgh of Motherwell. Accordingly in the spring of 1899 such an action was raised to interdict that burgh from polluting the Clyde and its tributaries by permitting its sewage to flow into them. This was looked upon as a test case, as some of the other burghs joined issue with Motherwell. After hearing evidence at length, the Sheriff-Substitute found it proved that the defenders had contravened the Rivers Pollutions Acts in knowingly permitting sewage matter to flow into tributaries of the Clyde. Against this decision, which was given in the spring of the following year, the defenders appealed to the Sheriff-Principal, who dismissed the appeal because of non-appearance of the defenders. Defenders then appealed to the Court of Session, when again the appeal was dismissed. In his interlocutor, the Sheriff-Substitute had remitted to an engineer of skill to examine the tributaries polluted, to hear parties, and to report to the Court on the best practical and available means of preventing the flow of sewage into these tributaries, or of rendering the sewage matter harmless, and the nature and cost of the work and apparatus required. Objections were taken by defenders to the report of the engineer, but ultimately, the

Court, in February 1903, ordained the defenders as soon as reasonably practicable to execute the work in accordance with his reports.

In 1903, Dr Wilson, Medical Officer of Health to the County of Lanark, issued a most valuable and exhaustive report regarding the administration of the Rivers Pollution Acts in that county, and from it I have taken many of my facts, adding to these what has fallen within my own personal knowledge. In order to form a contrast and comparison with the condition in the present year, 1907, let me place first the facts relating to pollution from sewage in 1903, and then the facts relating to the present year.

In 1903, the following burghs, which more or less directly discharged their sewage into the Clyde, had no sewage purification works, viz.:—Airdrie, Coatbridge, Hamilton, Lanark, Motherwell, Rutherglen, and Wishaw. An exception, however, must be made in the case of Wishaw, because, since 1860, the sewage of that burgh had received some measure of purification by being submitted to the purification which broad irrigation can give, the sewage being distributed over land of about 160 acres in area between the burgh and the river. This, however, has been found to be very unsatisfactory, serious pollution of the Clyde arising from the operations (1905). A qualification must also be made for Rutherglen, since shortly before 1903 an arrangement was concluded by which the sewage of the burgh was to be taken into the Glasgow South-side Sewage Scheme; at the same time, by reason that that scheme is not yet completed, the crude sewage is still being discharged into the Clyde. Excluding Wishaw, but including the others, it appears that the sewage of a population of 146,000 persons was being discharged into that river or its tributaries.

From special drainage districts in 1903 in the Upper Ward, the sewage of 6600 persons found its way into the river or its tributaries, and the sewage of 5200 persons was purified by broad irrigation; from like districts in the Middle Ward, the sewage going riverwards untreated came from 60,000 persons, while that of districts with a population of 22,700 was passed in after treatment; and from districts in the Lower Ward, the sewage of about 10,800 persons was untreated before going into the river, although that of 5300 persons of the foregoing figure had been arranged for treatment, while the sewage of 16,000 persons was already undergoing treatment. Moreover, not a few village communities, rows of miners' houses, and public institutions had systems of purification already installed. Summing up the foregoing figures, it would appear, therefore, that in 1903 the sewage of a total number of about 243,000 persons was being discharged into the Clyde or its tributaries. It must, however, be understood that, by reason of the discharge of some of this sewage into tributaries at some distance from the Clyde, some measure of purification had been attained before the river was reached, the smaller streams, however, being in many of these cases notoriously polluted.

The position in 1907 in this respect is a pleasing contrast. Purification systems have been introduced and are in operation in the burghs of Lanark and Hamilton, additional purification works are in progress, or powers have been obtained for such, in Wishaw and in Motherwell, while provision has been made for the incorporation of the sewage of Rutherglen in the Glasgow scheme, and the burghs of Airdrie and Coatbridge are being pressed to proceed to institute works. With regard to these last-named burghs, the following particulars will be of interest as indicating the lines of opposition which have been raised against the action of a County Council in enforcing the provisions of the Acts. The County Council raised an action against the Burgh of Airdrie under the Rivers Pollution Acts. The Burgh pled *inter alia* (*a*) that the County Council had no title to sue, and (*b*) prescriptive right. The Sheriff-Substitute, on 16th November, 1905, repelled both of these pleas, but granted leave of appeal. Appeal was made by the defenders to the Sheriff Principal, who, on 8th March, 1906, recalled the above interlocutor, repelled the first plea in law for the defenders, and appointed parties to be further heard on 21st March. In a note to his interlocutor, the Sheriff-Principal said relative to prescriptive right, "If the streams mentioned in the petition are streams in the sense of the Act, prescription, as was pointed out in the Pumpherston and Oakbank case, and in previous authoritative statements of the law, gives no person a right to pollute a river or stream; it only deprives lower heritors, by acquiescence, of their rights to object, and it can have no effect against a public authority endeavouring to enforce the provisions of this Statute, which (Section 8) it may do even against another sanitary authority." On 19th April, 1906, the Sheriff Principal, having heard parties, "Finds that the defenders admit that they are permitting sewage matter to fall or flow or to be carried into the streams condescended on in the petition. Finds that they are thus committing an offence against Section 3 of the Rivers Pollution Prevention Act, 1876; . . . before making a remit, as directed by Section 10 of the Act, appoints parties to be heard as to the terms of the remit on Wednesday, 2nd May next, at 11 a.m." In a note to this interlocutor, the Sheriff dealt with the plea of the defenders that the pursuers, as County Council had no title to sue; and in repelling it, he remarked that he could only look upon Section 55 of the Local Government Act as adding the County Council as another authority entitled to enforce the Pollution Acts. "Probably," he adds, "it was thought that the Act was not duly enforced, and that the newly-instituted County Council should be invested with powers in addition to other sanitary authorities, whether created by the Act or previously existing. And it is to be observed that the section not only invests the County Council with 'powers,' but imposes on it 'duties.' This disposes, I think, of the point, which was more than once put forward, that the County Council had no 'interest' to prosecute. I apprehend that an interest is not required when Parliament imposes a duty. But, even if it were not so, has not the county an interest in the purity of its rivers?"

The case against the Burgh of Coatbridge was identical in procedure, pleas in law for defenders, and in findings of Court, as in the Airdrie case. It may be taken, therefore, that with these two cases, the County Council has exhausted its possible actions against the burghs within the county, the sewage of which enters the Clyde to pollute it.

In several of the special drainage districts there is the same story to tell, and, therefore, it will be seen that very considerable progress has been made in freeing the river from contamination.

Another marked source of river pollution is trade pollution from objectionable effluents.

In 1903, the trade effluents which had to be inspected and sampled came from the following trade processes within the county, viz.:—coal-washing operations at collieries, spent ammonia from works in which ammonia was manufactured as a bye-product, paper mills, print-works, dye-works, oil works, chemical works, and distilleries and breweries. Of these there were 106 in all, samples numbering 1134 were taken, of which no fewer than 870 were of coal washing effluents, and 192 pollutions were detected in the course of the year. Of these pollutions some further notice must be made.

1. *Coal-washings.*—In 1903 there were in all 72 coal-dross washers at work at different collieries, and reckoning an average

day's washing at each place at 200 tons, which is a very moderate computation, the total daily amount of coal washed would not be less than 14,400 tons. The effect of washing coal-dross is to throw into the wash-water a varyingly large amount of fine clay and coal particles which, passing into a stream, at first remain largely in suspension until a suitable opportunity occurs in quiet pools for sedimentation to take place. The effect on the bed of the stream is to silt up certain parts, and, in some cases, even to obstruct the flow of the stream. The amount of solid matter in suspension varies in different effluents, being so low occasionally as about 60 grains per gallon, but more commonly much higher, rising at times, indeed, to over 1000 grains per gallon.

One of the earliest cases—if not, indeed, the very first case—of pollution due to coal-washings to be tried before the Court was one in which I was engaged to make inspection of the stream and to make analysis of the polluted water thereof. This was initiated in 1896, and proof was heard early in 1897. It was an action raised at common law by a down-stream riparian proprietor, Cuninghame *v.* The Lesmahagow Coal Co., Ltd. The degree of impurity from admixed coal-washings may be gathered from the simple statement which I made in one of my reports, viz.:—a clear silver coin could not be seen at a greater depth of water than a half inch column. The amounts of total solids in suspension in the stream were, near the source of pollution, 433 grains per gallon, and a little lower down the stream, 320 grains per gallon.

The second class of trade pollutions is that in which spent ammonia products from iron works, gas works, gas-liquor works, shale oil works, and chemical works, are apt to be discharged into streams. This form of pollution is exceedingly fatal to fish. Not only has this been proved to have been the case with respect to rivers in Lanarkshire, but also in Ayrshire at Kilbirnie Loch and in the river Doon. These spent products contain phenol and cresol compounds, commonly called tar oils. The following two cases show what has taken place in this regard with reference to pollution, and also to legal action to enforce cessation of the same. These effluents, it may also be added, come under the language of the Act in respect that they are poisonous, noxious, and polluting liquids. The fish experiments indicate their disastrous effect upon fish life in streams.

Against polluters by trade effluents the County Council has had to invoke the aid of the law. The first case which was raised was against a chemical company, the object of the action being to restrain from discharging into the North Calder Water any poisonous or noxious liquid effluent from their works, and so polluting the river. After a long proof, the Sheriff-Substitute gave decision in favour of the defenders, but on appeal by the County to the Sheriff-Principal, the decision of the Sheriff-Substitute was reversed. Appended to his judgment, the Sheriff gives a lengthy note in which he reviews the evidence for both sides, and narrates the points of the evidence upon which he founded in giving his judgment. He gives prominence to the report made by the inspector to the Secretary of Scotland for the purpose of enabling the Secretary for Scotland to give or withhold his consent to the prosecution by the County Council. In this report, the inspector says that the defenders were polluting the river by spent ammoniacal liquor, and, he thought, by some added substance of a red colour. The Sheriff accordingly found in terms of the prayer of the petition of the County Council, and remitted it to a civil and mining engineer to report on the best practicable and available means for preventing the pollution of the stream in the manner aforesaid.

Another case was raised by the Council against an iron-works' company similar in nature of pollution and of legal relief asked to the preceding case. I was engaged by the Council to make an inspection of the river and to make analyses of effluents and river, together with such other experiments as might be deemed necessary in order to show whether or not the effluents from the defenders' works were poisonous, noxious, and polluting. On examination, I found the effluent to be of a dark colour, varying from a dark sherry to a brownish-black colour, which could be tracked in the stream after its entrance thereinto by the discoloured and frothy appearance it imparted to the water of the Clyde. Moreover, the effluent gave off a more or less well-marked odour of what might generally be designated as carbolic acid products. In all, six samples of the effluent were taken for analysis, and one sample of the river water twenty yards above the point of entrance of the effluent. Two of the samples of the effluent and the sample of river water were taken by myself on the same day at the same time, the other three having been taken on different days by the county sanitary officials and forwarded to me. Experiments were made upon fish with each of the six samples of effluents.

The following Table shows the results of analyses, and the amount of constituent substances which were poisonous and noxious and polluting.

TABLE I.—SHOWING CHEMICAL CONSTITUENTS.
In grains per gallon.

No. of Sample.	Total Solids.	Mineral Solids.	Organic Solids.	Total Tar (phenols and cresols) Oils.	Oxygen consumed 80° F., 3 hours.
I.	112·9	42·98	69·92	24·22	59·92
II.	75·88	56·56	19·32	28·80	29·33
III.	113·4	77·28	36·12	32·20	47·94
IV.	95·37	71·85	23·52	11·55	50·63
V.	89·95	58·10	31·85	10·15	35·34
VI.	94·85	65·10	29·75	8·75	44.80
River Water	12·6	7·84	4·76	None	0·363

TABLE II.—SHOWING PHYSICAL APPEARANCES.

Colour.	Odour.	Suspended matter.
I. Brownish-black. Opaque.	Strong odour of carbolic derivatives.	Very abundant. A fine dark-brownish-black sediment on standing.
II. Pale sherry.	Odour as above. Not so strong as above.	Coarse and fine, dark-coloured, flaky matter, abundant, sedimenting on standing.
III. Dark reddish-brown, almost black. Opaque.	Strong odour of carbolic derivatives.	Exceedingly abundant.
IV. Dark sherry, or tawny port.	Marked odour as above.	Very abundant, fine matter, sedimenting on standing.
V. Dark sherry.	Perceptible odour of above.	Abundant fine matter, sedimenting on standing.
VI. Dark sherry or tawny port.	Marked odour of carbolic derivatives.	Abundant coarse and fine matter, sedimenting on standing.
River. Very pale straw.	None.	Abundant coarse and fine matter, sedimenting on standing.

The following particulars will show the results of the effluents upon fish. The fish used in the experiments were minnows, gold-fish, one-year-old trout, and two-year-old trout.

SAMPLE I.—GOLD-FISH USED.

The experiments were made with different percentage amounts of the effluents mixed with Loch Katrine water from the tap.

The fish were placed in mixtures at 11 a.m. on 21st Nov.

Percentage of Effluent in Mixture.	20°/₀	10°/₀	5°/₀	2½°/₀	Control Exper. Pure L. Katrine.
Life of fish in hours.	22	30-46	52	267	Alive 21st Dec.

SAMPLE II.—GOLD-FISH USED.

Effluent percentage.	20°/₀	10°/₀	5°/₀	2½°/₀	Control Exper. Pure L. Katrine.
Life of fish.	66	70	180	Alive 21st Dec.	Living and lively on 21st Dec.

SAMPLE III.—MINNOWS USED.

Fish placed in mixtures at 1.35 p.m. on 28th Nov.

Effluent Percentage.	30°/₀	20°/₀	10°/₀	Control. L. Katrine.
Life of fish.	30 min.	(1) 30 min (2) 40 min.	12 hrs.	Living 21st Dec.

SAMPLE IIIA.—TWO-YEAR-OLD TROUT, measuring 8 inches long.

Trout placed in 20°/₀ mixture at 2 p.m., 30th Nov.

Effluent Percentage.	20°/₀	Control. L. Katrine.
Life of fish.	10 minutes.*	Quite lively several hours after.

* *Note.*—The trout became sickly at once, floating belly upwards.

SAMPLE IV.—TWO-YEAR-OLD TROUT USED.

Two fish placed in each mixture at 10.42 a.m. on 3rd Dec.

Effluent percentage.	20°/₀	15°/₀	10°/₀	5°/₀	Control. L. Katrine.
Life of fish in hours.	13 min. (both)	13 min. (both)	18 min. (both)	153 min. 163 min.	38 hours

IVA.—MINNOWS.

Effluent percentage.	20°/₀	15°/₀	10°/₀	Control. L. Katrine.
Fish died.	(1) 21 min. (2) 33 min.	34 min. 46 min.	341 min. (both)	Living on 21st Dec.

SAMPLE V.—TWO-YEAR-OLD TROUT, 8 inches long.

Trout was placed in 20°/₀ mixture of effluent and L. Katrine at 2.20 p.m. on 30th Nov.

Result.—The fish was in distress in two minutes, was swimming belly up in three minutes, and was dead in ten minutes.

I have found from experience of many fish experiments that it is advisable to use different kinds of fish, because if gold-fish alone are used, they do not give the most sensitive results, owing to the fact that they have been acclimatised to live in artificial circumstances. My experience points to yearling and two-year-old trout as being the most useful and sensitive fish to employ. Chemical pollutants differ in their effects upon fish. They operate in two different ways, viz., (*a*) by the solution of poisonous substances in the water, which, by absorption into the bodily economy of the fish, poison the fish; and (*b*) by using up the oxygen which is dissolved in the water. Besides, suspended fine solids, if of a poisonous nature, operate prejudicially on fish life, but they act less rapidly than dissolved poisonous ingredients. So far as my experience goes, the best available means whereby the poisonous and noxious character of a trade effluent may be proved are (1) by chemical analysis, and (2) by experiments on fish life. To these may be added, under special circumstances, (3) the effect upon plant life, as ascertained by examination of the bed and bottom of the stream under consideration. From the foregoing facts of the case under consideration, I felt able to say without hesitation that the effluents in question were of a poisonous and noxious and polluting character, and gave evidence accordingly.

After hearing proof, the Sheriff-Substitute found that defenders had contravened Section 4 of the Act in respect that they were proved to have discharged into the Clyde spent liquor such as to be a poisonous, noxious, and polluting liquid at the point where it flowed into the Clyde.

Of the other forms of trade pollution little needs be said. Paper is made at four works within the county, two in the neighbourhood of Caldercruix, and other two in the neighbourhood of Rutherglen. The effluents from the latter two will discharge into the Glasgow South-side Sewage Scheme. At the former two works settling tanks have been provided, in which the sludge collects, and is removed at periodic intervals, the effluent passing into the North Calder River, a tributary of the Clyde. The dye-works, printing works, and bleach works have also been provided with similar arrangements. Pollution from distillery effluent, or pot-ale, is not likely to bulk largely in this county, since there are only two distilleries, one discharging its effluent into the Wishaw drainage system, the sewage of which is treated on land by broad irrigation, and the other, at Garnkirk, into the system of an adjacent district sewage system, after the solids in suspension have been intercepted.

From what has been said, therefore, with regard to the prevention of effluents from manufacturing and mining operations, and to the purification of sewage, it will be obvious that in spite of the difficulties of the Pollution Acts, the County Council of Lanark has achieved rapid progress and effectiveness in the work of prevention, for which it deserves the heartiest praise.

The tale of excellent work done by this Council relative to the Clyde may be thus briefly summed up in the following narrative. For this purpose, we may adopt the four reaches of the river which form the divisions used by Dr Wilson, viz.:—

First.—From confluence of the head waters, Daer and Potrail, to Castlebank, Lanark (40 miles); *Second*—From Lanark to Clyde Bridge over Clyde at junction of Avon and Clyde, near Hamilton (15 miles); *Third*—From Hamilton and Motherwell highway bridge over Clyde at Hamilton to Carmyle Weir; and *Fourth*—From Carmyle Weir to Rutherglen Bridge, Glasgow.

Division I.

Industrial Pollutions.

(*a*) Lead-mining, Leadhills; (*b*) Shale Oil Works, Tarbrax; (*c*) Coal-washing, Coalburn.

In 1904, a serious destruction of trout in the Glengonnar burn, which receives the effluents from lead-mining operations at Leadhills, took place. One trout was examined in the County Council Laboratory, but no evidence of lead was found in its body. I examined several trout sent me by the Angling Association for the same purpose, but with a like result. It appeared to me that the fish had died from abstraction of oxygen from the water of the stream. I have watched the effects of similar operations in one small stream in Dumfriesshire into which similar effluents from like operations at Wanlockhead enter. Trout cannot be found within some distance below the point at which the effluents enter, the water of the stream being milky in appearance for some considerable distance below that point. The view at which I have arrived concerning the absence of fish is that already given, viz., the depletion of the oxygen of the stream by the products in the effluents.

Sewage Pollutions.—There are three special drainage districts in this division :—

Pop.	
1,000	(*a*) Carnwath. Sewage works constructed, tanks and filters.
400	(*b*) Crosslaw. Sewage irrigated on land.
1,440	(*c*) Douglas. Sewage intercepted in cesspool tank, which is cleaned regularly of solids.
800	(*d*) New Lanark. Sewage works, tanks and filters.

Division II.

Industrial Pollutions.

(*a*) Coal-washers = 13
(*b*) Ammonia works = 3
(*c*) Bleach-work = 1
(*d*) Distillery = 1 = 18 total.

In (*a*) and (*b*) proper preventive measures against pollution provided; effluents of (*c*) and (*d*) provided for in sewers of Burgh of Wishaw.

Sewage Pollutions.

Three burghs. Seven special drainage districts.

5,153 (*a*) Lanark. Bacterial purification works in operation.

21,727 (*b*) Wishaw. Irrigation on farm lands. Burgh got provisional order in 1903 for new works. In 1906, new large intercepting sewer under construction. Present system most imperfect. It was causing serious pollution of Clyde in 1904. I inspected system in that year, and found river polluted from sewage therefrom.

32,495 (*c*) Motherwell. Order of Court in 1903 to proceed with remedial works. Work for one outfall now in progress. 32,495

Special Drainage Districts.

2,180 (*a*) Lesmahagow. Sewage enters burn which enters Nethan. 2,180

2,080 (*b*) Law. One outfall irrigated on farm. Other enters Gill burn, affluent of Clyde. 2,080

4,510 (*c*) Strathaven. Sewage purified in works.

3,300 (*d*) Stonehouse. Sewage partly irrigated. Construction of complete works hindered for want of getting land. 2,200

12,990 (*e*) Larkhall. Sewage irrigated on meadows.

1,840 (*f*) Netherton. Four-fifths of sewage treated in works. 400

DIVISION III.

Industrial Pollutions.

Bleach work = 1
(*a*) Coal-washers = 35 Paper mills = 2
(*b*) Ammonia works = 13 Print works = 1 = 52 total.

Suitable means for preventing pollution have been provided in all these works. Legal action had to be taken against three of them, viz. :—two coal-washers and one ammonia works. In each case, the Court ordained best practicable means available to be adopted, with satisfactory results.

Sewage Pollutions.

Four Burghs. Twelve Special Drainage Districts.

	(*a*)	Motherwell. Legal action had been taken against Burgh by County Council in 1899. An order given by Court ordaining burgh to construct sewage purification works. Plans and estimates were obtained for one outfall. Works now in progress. Outfalls into streams in Middle Ward not yet dealt with.	
35,700	(*b*)	Hamilton. Purification works for one outfall opened this year. Cadzow burn scheme delayed by various difficulties.	18,000
23,690	(*c*)	Airdrie. Sewage discharged in crude state into small streams entering North Calder Water, Legal action raised against Burgh by County Council in 1905. Court in 1906 found that Burgh was committing an offence against Acts. Remit to man of skill to be considered.	23,690
40,205	(*d*)	Coatbridge. History same as that of Burgh of Airdrie. Remit to man of skill to be made.	40,205

Special Drainage Districts.

2,980	(*a*)	Tannochside. Sewage drains to Uddingston.	
4,920	(*b*)	Baillieston. Land for sewage works for whole district obtained. Western part in construction.	4,920
12,870	(*c*)	Bellshill. Purification scheme before Committee.	12,870
14,690	(*d*)	Blantyre. Works for one outfall in operation. Works for other under consideration.	7,000
3,610	(*e*)	Bothwell. Sewage from one-half of district treated at Fallside or Uddingston. Crude sewage of other half runs into Clyde.	1,800
2,640	(*f*)	Carfin. District formed. Land acquired for works.	2,640
2,010	(*g*)	Chapelhall. Sewage finds outlet into North Calder.	2,010
2,390	(*h*)	Cleland. Purification works provided, tanks and filters.	
1,970	(*i*)	Holytown. Sewage untreated.	1,970

2,950	(*i*)	New Stevenston. Sewage untreated. Joint works for this district and Holytown under consideration.	2,950
5,280	(*k*)	Newton and Flemington. Sewers constructed. Sewage treated in septic tank only.	
8,350	(*l*)	Uddingston. Sewage of one-third of population treated in purification works. Works for whole district under consideration.	5,800

DIVISION IV.

Industrial Pollutions.

(*a*) Coal-washers = 3
(*b*) Ammonia works = 2
(*c*) Paper works = 2
(*d*) Bleach works = 3
(*e*) Chemical work = 1
(*f*) Distillery = 1 = 12 total.

All these, except the three coal-washers and the two ammonia works are provided in Glasgow sewage schemes. In these works proper means for preventing pollution are provided. But legal action had been taken against one coal washer and one ammonia works.

Sewage Pollutions.

One Burgh. Four Special Drainage Districts.

18,700	(*a*)	Rutherglen. Provided for in Glasgow South Side sewage scheme.	

Special Drainage Districts.

17,150	(*a*)	Cambuslang. Committee considering whether to apply for admission of sewage into Glasgow scheme.	17,150
4,280	(*b*)	Mount Vernon. Crude sewage admitted into streams draining into Clyde.	4,280
26,880	(*c*)	Shettleston and Tollcross. Part sewage treated in Glasgow Dalmarnock Works. Rest enters Clyde.	15,000
5,500	(*d*)	Rutherglen (landward). Drainage district formed. Sewage to enter Glasgow system.	
326,670			199,640

It will be noted that the sewage of institutions, public and private, and of small villages, which are provided with purification works, are not included in the above list. Such are to be found in the first three of the foregoing divisions. Further, it is evident that the population which is on the watershed of the Clyde or its tributaries numbers over 326,000, and of that total nearly 200,000 still pollutes these rivers with their sewage. But of that 200,000, the sewage purification arrangements are in process of maturing for 150,000, these arrangements being in the stage either of Orders of Court to purify, or works in process of construction, or works under consideration.

The final tale of work, therefore, of the County Council is worthy of the highest praise.

COUNTY OF DUMFRIES.

In the beginning of 1897, it had to be written regarding the river Nith that "it receives the sewage of New Cumnock, Kirkconnel, Sanquhar (partly treated), Thornhill, Maxwelltown, and Dumfries," and that it also received in its upper reaches coal-washing refuse in no inconsiderable amount. Here also must a new record be made, for its main sources of pollution have been stopped.

Coal-washing pollution has been almost entirely, if not wholly, removed. The County Council represented to colliery owners that débris from coal-washing operations must be treated within the works before the effluent could be permitted to enter the rivers or streams; and that has been effective.

The main pollution by sewage was that by the burghs of Maxwelltown and Dumfries, the sewers of which emptied their crude sewage below tidal water-level. Now that also has ceased. The operations for purification of sewage, which these burghs had to introduce, were instituted as the result of the finding of Commissioners appointed by the Local Government Board at the instance of the County Council.

The question arose out of the proposal of one of these burghal authorities to construct a new sewer whereby to carry into the river the untreated sewage of the inhabitants of certain houses within the burgh. Objections were made to the proposal by the County Councils of Dumfries and the Stewartry of Kirkcudbright and others, and petitions were lodged asking that it be determined by the Commissioners representing the Local Government Board and the Secretary for Scotland that the tidal waters of the Nith should be deemed a "stream" within the meaning and for the purposes of the Rivers Pollution Prevention Act, 1876. I was asked by the County Council to report on the condition of the river, and gave evidence at the enquiry. After hearing evidence on several days, and after personal inspection of the river, the Commissioners agreed that they would delay reporting to the Secretary for Scotland and the Local Government Board for one month to give the various parties time to intimate the appointment of an efficient engineer, on the understanding always that a proper scheme of purification would be formulated within a year. Such a scheme was duly formulated, and sewage-purification works have been installed and are now in operation.

Consequent upon this, the County Council put their powers in operation, and compelled the institution of sewage-purification works in Sanquhar and Thornhill. It may now be said, therefore, that the Nith has been rendered free from pollution.

The pollution of the Esk at Langholm will soon be a thing of the past, as a purification scheme has been agreed to.

In 1903, a case of no little interest and importance was raised at common law by His Grace the Duke of Buccleuch and Queensberry against the Commissioners of the Burgh of Lockerbie. The pursuer sought that the Court should find and declare that the water of certain streams flowing past the sewage works of the defenders should be transmitted to him in a state fit for the use of man and beast, and for other primary purposes of running water, and that the defenders had no right to impair the natural quality of the streams to the prejudice of the pursuer, or otherwise that he was entitled to have the water, as it flowed through his lands, transmitted to him so as not to cause a nuisance; and that the defenders should be interdicted from discharging into said streams sewage of any kind, or from otherwise polluting the same, whereby they were rendered unfit for primary purposes. The defenders, in 1888, constructed sewage works to treat the sewage of Lockerbie. Generally, these works consisted of septic tanks and primary or coarse contact beds. It was alleged for the pursuer that a dam used for storing water of the stream for working a mill on pursuer's lands became silted up with sewage matter, and that the stream itself contained similar deposits. I was asked by pursuer's law-agents to inspect the said works and stream, which I did on several occasions between 1900 and 1903. In addition, I made many analyses of the water of the stream at many points, chemical and bacteriological, as well as of the mud formed in the bed of the burn and of the dam mentioned. My conclusions were that the burn was seriously contaminated. Proof was partially heard in June 1903, when the defenders evinced a desire to agree generally with the demand for increased purification works. A schedule of the required works was drawn out, and the parties by joint minute agreed to withdraw the case, the defenders undertaking forthwith to construct the additional works specified to the satisfaction of an engineer appointed for the purpose, and the pursuer to accept the works when duly completed as structurally sufficient, the cause to be continued till 1904 to permit of these works being executed.

COUNTY OF CLACKMANNAN.

The condition of the rivers of this county is practically identical to what it was in 1897. Said the Medical Officer of Health in his report of the river Devon in 1893, "At Cambus the water has lost the semblance of water, and has become a dirty, foul-smelling, complex chemical compound of sewage, acids, alkalies, and dyes." That is the state of the Devon to-day. The reason for this lies in the fact that when an attempt was made by the County Council to purify the river, the manufacturers applied to the Secretary for Scotland to stay the proceedings on the ground that such would be inimical to the industrial interests involved in the case, in which application they were successful.

COUNTY OF FIFE.

All of the streams in this county are practically as badly polluted as in 1897, if not, in some instances, worse polluted than at that time. Notwithstanding that in the summer of 1896 the pollution of the Leven was so bad that the Medical Officer of Health reported it to be a nuisance to the Kirkcaldy District Committee, nothing had been done up till the spring of 1903 to bring the polluters to task, despite the fact that the permission of the Secretary for Scotland had been asked and had been granted to proceed against the polluters. So far as I know, nothing has been done in this direction even since 1903.

An interesting case arising out of the pollution of the Leven, in which I made examination of the river and gave evidence in Court, deserves some attention. The facts are these:—The Kirkcaldy District Committee, early in 1903, raised an action against the

North British Railway Company, asking the Sheriff to pronounce the Leven Dock, Leven, the property of the Railway Company, to be a nuisance or injurious or dangerous to health because of an accumulation of offensive matter lying therein, and that said accumulation was a nuisance within the meaning of the Public Health (Scotland) Act, 1897, section 16, sub-sections 1 and 5; and further to find that the defenders were the authors of the said nuisance. It was further alleged that the condition had become a nuisance because of the defective character of the dock gates, whereby "the dock had now become a receptacle for sewage and other offensive matter brought down by the river Leven, and accumulating in the neighbourhood of the Burgh of Leven."

In the answers for the defenders, it was stated that if a nuisance did exist, it arose from filth in the river Leven, and the defenders were not the authors of it, and, in particular, that the filth came from certain sewers from the burgh of Leven, which were specified, as well as from the river higher up.

I made an inspection of the *locus* early in March, 1903, and found that much of the dock was silted up with an accumulation of fine, dark-coloured matter, which, when stirred, gave off considerable amounts of foul-smelling gases, notably H_2S and NH_4HS. The character of the deposit exhibited the characteristics of sewage matter. The accumulation was from two and a half to three feet in depth. I further reported that "there exists no room for doubt that the condition of the dock constitutes a nuisance, due to the considerable deposits of fine silt highly charged with sewage matter, and that this accumulation of offensive matter is injurious and dangerous to health." But from the inspection of the dock and the adjacent river, which ran alongside the dock wall, I was able to affirm positively that the defenders were not the authors of the nuisance in the sense that they were not the originators and perpetrators of it. This conclusion was reached because (1) no sewage pipe of any description opened into the dock; (2) that several sewers from the burgh on its north side, both above and below, emptied their crude contents into the river, and that this was dammed back by the tide; and (3) that the river Leven itself was in a very polluted condition. Notwithstanding the foregoing facts, the Sheriff found that the defenders were in law the authors of the nuisance, ordered the Company to repair the dock gates, and to clean out the dock. It would not be seemly to discuss the legal aspects of the decision, but this is a case where the pollution admittedly was not due to the defenders, except in so far as the gates of the dock, being in a state of some disrepair, permitted the pollution from other authors to enter their dock, and to silt it up in the form of an offensive accumulation of sewage-laden mud, from which foul and malodorous gases were evolved to cause a nuisance. One cannot help observing that if the District Committee had carried out their duty to compel up-stream polluters to cease the practice, as they had obtained powers from the Secretary of Scotland to do, and had the burgh of Leven treated its sewage, no such nuisance could have arisen in this dock, condition of gates notwithstanding.

COUNTY OF MIDLOTHIAN.

The present condition of the streams in this county is practically similar to what it was in 1897. The Almond River is little better than a prolonged sewer. As the Medical Officer of Health said of it in 1891, "fish cannot live in it; horses, cattle and sheep drink sparingly of it, if at all, and for industrial purposes it is almost useless, on account of its destructive effects upon boilers," so is it to-day. The river still receives the trade effluents from a variety of manufacturing processes, chiefly, however, those from the paraffin-oil industry, not to speak of coal-washings, sewage, and other pollutants. There exists, at the same time, within this county, an object lesson of a filthy sewer-like river becoming a clean water stream, viz., the Water of Leith, which flows through the north side of Edinburgh. Formerly but a sewer, it has now become of such purity that fish thrive in its waters and angling has been re-established.

COUNTY OF DUNBARTON.

The condition of the Leven to-day is substantially as bad as it was in 1897. I have had several opportunities within the last year of making observations of the river. It receives practically all the sewage of all the populations on its banks in its short course of seven miles from Loch Lomond to the Clyde. This river differs from most rivers in the south of Scotland in this, that it rises full-fledged as a river from a loch, and while the amount of water which it contains is liable to fluctuations of level of the loch itself, it always contains a fair body of water. The sewage of Balloch, Alexandria, Renton and Dunbarton flow into it, and, in addition, the trade effluents from several calico-printing and other works. Its condition as a fishing river is seriously damaged by reason of this pollution. While it is not unlikely that some portion of the trade effluents from these works may be relatively innocuous to fish life, it is at the same time clear to me from my observations that not a little of the total amount corresponds to the poisonous, noxious and polluting liquid of the Pollution Act. The river runs in rainbow-like colours most days of every week while the works are in operation, the predominant colour on any particular day depending on the individual operations in these works.

In addition to the information which I have gathered from personal inspection of the river, some interesting details of the character of the effluents from the works along its banks may be obtained from the report of the Medical Officer of Health for 1904.

Extensive sampling of effluents from factories situated on the Leven was made in November, 1902, and the reports of the analyses thereof were given in April of the following year. The following works send their effluents into the river, viz., (1) Dalmonach, (2) Croft, (3) Levenbank, (4) Milton, (5) Millburn, (6) Cordale, (7) Dalquhurn, (8) Dillichip, and (9) Ferryfield. From these, taking the works in the above order, the samples bore the following respective colours, viz.:—(1) pinkish, milky-looking, dirty mahogany colour; indigo blue; bright green; (2) pale greenish-yellow; faint pink; red; greenish; (3) orange-brown; green; pale yellow; (4) milky; pale pink; (5) pale yellow-brown, with pyroligneous smell; (6) milky-white, with considerable amount of suspended matter; (7) strong pink; strong purple; strong reddish purple; (8) pale pink; (9) deep pinky-brown; blue tinge. For variety of tints the above would be difficult to match. Taking the works in the same order, the total solids in suspension and in solution were as follow:—

(1) From 5·75, in lowest sample, to 158·94, in highest sample, grains per gallon; there were traces of free fatty matter (tar acids?) in three out of four samples; there was no chlorine and no chromium; the reaction in three of the samples was slightly alkaline.

(2) From 24 to 47 grains per gallon; traces of free fatty matter in two out of three samples; chlorine, 0·45 grains per gallon, found in one sample, and 0·34 grains per gallon in one sample; no chromium in any sample; two samples were slightly

alkaline, one neutral, and one was acid, the acidity being equal to 0·14 grains per gallon in terms of sulphuric acid.

(3) Three samples were mixed to form one sample, and this contained 37·96 grains per gallon; there were traces of fatty matter; no chlorine or chromium; reaction, slightly alkaline.

(4) Three samples in one, as above; mixture contained 16·38 grains per gallon; free fatty matter, 0·8 grains per gallon; no chlorine or chromium; reaction; slightly alkaline.

(5) Four samples from this chemical work were united to form one, and four others to form a second. Total solids in each was 25·69 and 14·47 grains per gallon respectively; both contained free fatty matter (tar acids), in one to the extent of half a grain per gallon; no chlorine or chromium; reactions in both, slightly alkaline.

(6) Four samples from discharge from bleaching powder tank mixed together formed *A*; same number from mouth of lade in to river, *B*; and same from colour shop tank, *C*. *A* contained 505 grains per gallon of total solids, *B* 5·31, and *C* 72·76. In *A* there were 60·2 grains of chlorine per gallon, and traces in *C*; in *B* there was a trace of chromium; there was free fatty matter in *B* and *C*; the reactions were slightly alkaline.

(7) Total solids in all the samples varied from 5·67 to 24·32 grains per gallon; none of them contained free fatty matter, chlorine or chromium; reactions were slightly alkaline.

(8) Total solids 14·84 grains per gallon (six samples mixed to form one); free fatty matter found, 0·45 grains per gallon; no chlorine or chromium; reaction neutral.

(9) Three samples mixed formed *A*, and three other samples formed *B*. Total solids in *A* 30·58, and in *B* 49·14 grains per gallon; traces of free fatty matter in *A*; no chlorine or chromium in either; reactions slightly alkaline.

The only remarks which might be made concerning these results is that it is a questionable practice to mix effluents taken at different times of the day and thus artificially manufacture an effluent, the analysis of which is given, but which has never existed as such, since most erroneous conclusions are apt to follow the interpretation put on the analysis. For example, in the samples taken from the work which we have marked above as No. 9, I find in the description of the taking of samples that each of the three samples which formed *A* of the above is stated by the analyst to contain "a good deal of suspended matter";

and that of the three samples forming *B* of above, two are stated to contain "a small quantity" and one "a little suspended matter." When, however, we turn to the analytical results, we find exactly the reverse of what we might, from the language employed, expect, viz., in *A* 30·58, and in *B* 49·14 grains per gallon. One of two conclusions can only be made of these facts: either that the samples have been mis-numbered, or that the language concerning the amounts has been somewhat loosely applied.

Personally, we believe that each sample should stand on its own merits, and no such artificial effluents should be made by mixing.

There is one other aspect of the analyst's report to which attention must be drawn, viz., his observations concerning the polluting character of the foregoing samples. We quote: "It is scarcely possible to state in words the character or the quality of each sample, from the point of view of pollution or contamination of the river. It will be kept in view, however, that their strength or degree of offensiveness should not be judged by the same standards as ordinary domestic sewage, or even of manufacturing sewage of an offensive character, such as tannery or distillery effluents. It is the usual practice to judge of the degree of offensiveness by taking into account the figures for the organic matter in suspension, the albuminoid ammonia, and the organic matters in solution, which are oxidisable by permanganate of potassium; and the proportions of these are regarded as indicating the strength or otherwise of the sewage. If these 22 samples were judged by this standard, they would be regarded as dilute sewage; but this is far from being the case, because, for the same proportions of these objectionable matters, there would not be anything like the same putrescent quality as if they consisted of more or less dilute sewage. It would not be correct to arrive at the mean strength of these effluents by taking the average proportions of the objectionable ingredients which they contain, because the rate of flow will in every case be different, and the question of their diluting power in the aggregate should be considered on very general grounds."

It is quite probable that the analysts did not know for what purposes these samples were taken, and, if so, it is not difficult to understand their position. But if it was within their knowledge that the samples were being taken to indicate whether or not pollution was taking place in the sense of the Rivers Pollution Acts, then their position is not understandable, because these Acts are not sanitary Acts in any sense of the word. As we expressed this view before: "It is not a Health Act; indeed, there is not a phrase, not even a single word, in it which indicates that the Act was passed with reference to the public health." And, as Sheriff Guthrie expressed it in his Note to his interlocutor of 10th April, 1905: "The Rivers Pollution Prevention Act says nothing about nuisance." Therefore, the standard of pollution is not solely or exclusively or merely that of sewage, because trade effluents refuse to be so classified. Moreover, it depends upon the form of action raised. Suppose, for example, that the action has been laid by proprietors of salmon fishing on the river, the standard of impurity would be shifted in other directions; indeed, in such a case, the mere discharge of large volumes of boiled water into the river would form a legitimate complaint, inasmuch as, deprived of its oxygen, such water would not sustain fish life.

Leaving this on one side, however, and turning to the comments on the foregoing report by the Medical Officer of Health, we find that in some of the works there has been no change since 1897, and that remedial works suggested by him in that year have not been constructed. Speaking generally, however, he declares in his report that "there is considerably less pollution of the river Leven by the works on its banks than was the case when the County Council began to deal with the subject"; at the same time, he shows the need for further considerable improvement.

Not only so, but I have seen masses of tarry compounds floating in certain pools of the river, evidently coming from a gaswork or similar manufactory. The very large populations which already live in the immediate vicinity of the river, and the increase in population which is taking place by reason of the institution of new industries in the district, together with the increasing sewage pollution from increasing provision of water-closets, and trade effluents, demand that a sewage scheme should be instituted for the whole.

The other river of importance in this county is the Kelvin. There has been no substantial alteration in the character of this river during the last ten years. It is as highly polluted as ever by coal-washings and other trade effluents. The question of its purification will have to be faced immediately in view of the measures which have been, and are being, taken by the Lanarkshire County Council and the Corporation of Glasgow. It is impossible to contemplate that the present condition of this river could be permitted to continue after the enormous expenditure of money in these operations, particularly when it is remembered that it pours its inky flood into the middle of the harbour of this city and runs through its West-end park.

This river, by reason of its course, involves the consideration of several local authorities. These are the Central District of Stirlingshire, the Western District of Stirlingshire, the Eastern District of Dumbartonshire, the Middle Ward of Lanarkshire, and the burghs of Kilsyth, Kirkintilloch, Milngavie, Glasgow, and Partick. To these may, perhaps, be added the County Council of Lanarkshire, for pollution may reach the Kelvin from its tributary the Luggie, *via* the Garnkirk and Bathlin Burns. Dr M'Vail, in his annual report to the County Council of Stirling for 1904, remarks on the question of prevention of pollution of this river, "unless joint action can be agreed on, it will be very difficult to accomplish any very thorough purification of the stream where the interests are so varied and so divided." There can be no manner of doubt concerning the polluted condition of the Kelvin, whatever authority or authorities are responsible for its repression. The Luggie sends its quotum in the form of coal-washings and chemical effluents, and into the Kelvin itself both sewage and manufacturing pollutions are emptied.

It is satisfactory to record that a conference of the local authorities involved in its purification has been held at the invitation of the City of Glasgow, in August, 1904, for the purpose of considering the condition of the river at the part where it forms the boundary between the County of Dumbarton and the City of Glasgow. At this conference were also present representatives from the County Council of Lanarkshire. The share in the pollution of the last-named county seems to be a very small one. The Luggie, as has been said, comes from two head streams, the Garnkirk burn and the Bathlin burn, which receive the sewage from Stepps, Chryston, and Muirhead, and the Luggie itself, the sewage of Mollinsburn. Another tributary, the Cameron burn, may receive coal-washings from Darngavil Colliery, and some sewage from Greengairs. But the whole effect on the Kelvin must be trifling indeed, even if to that be added the sewage of the special drainage district of Bishopbriggs, which, passing into the burn of that name, finds its way into the Kelvin.

It would appear that the determination of the conference mentioned was to leave each local authority to take the necessary steps to check pollution within its own area.

As for the other smaller streams running into the Clyde, arrangements should have been completed for their purification. Samples have been taken from them by me in their polluted state in order to be able to contrast their composition when purification has had its effect. It is somewhat disappointing to find, by an inspection of Knightswood Burn which I made a few days ago, that this stream is still running in a highly polluted condition. It is highly polluted by sewage and by oily or creosote products, notwithstanding that an intercepting sewer runs on each bank of the stream, within a few feet, indeed, of the waterflow. The stream forms part of the divisional boundary between Renfrewshire, which sends a tongue in this direction, and Dumbartonshire. A special drainage district has been formed by the County Council of Renfrew on the south side of the stream, and a similar district by the Council of Dumbarton, on the north side of the stream. Yet despite this fact, the effluents from a large creosoting works have not been connected with the Dumbarton drainage district, and are still being permitted to flow directly into the burn.

From a survey, therefore, of the condition of the rivers of this county, it cannot be said that much, if any, progress in the direction of diminishing river pollution has been made during the last ten years.

COUNTY OF RENFREW.

In my report of this county in 1897, I drew attention to the state of the river Cart, which joins the Clyde opposite Clydebank. Then, it was a grossly polluted river, receiving pollutions from sewage and several different trade processes. Formed by the waters of the White and the Black Carts, which unite a few hundred yards above its confluence with the Clyde, and each of which is badly polluted—the Cart to-day is practically as polluted as it was ten years ago. At that time, it received the sewage of Busby, but since that time the town has been provided with a sewage purification system. Barrhead has also been provided, but its stream is grossly polluted from trade effluents. At that time also, the Cart received the untreated sewage of Thornliebank, Cathcart, Battlefield, and Langside, and Pollokshaws, in addition to that of Paisley and suburbs. Arrangements are being completed for the treatment of the sewage of Cathcart and other suburbs of Glasgow within the South side Scheme, but the sewage and trade effluents of the other places still remain untreated. It will thus be seen that substantial, if not, indeed, the main pollution of the Cart still remains.

COUNTY OF STIRLING.

The principal streams in this county, the Forth, Carron, Bonny, and Allan, so far as I have been able to gather information, have not been substantially made better in respect of pollution since last I drew attention to them in 1897. The Forth still receives the sewage of several small populous places, and of Stirling, which are situated on its banks. This last town contributes the largest sewage pollution of them all, but this portion of the river is tidal. It will be well in this connection to point out that the definition of a "stream" in the Rivers Pollution Act, 1876, runs as follows:—"'Stream' includes the sea to such extent, and tidal waters to such point, as may, after local enquiry and on sanitary grounds, be determined by the Local Government Board, by order published in the *London Gazette.* Save as aforesaid, it includes rivers, streams, canals, lakes, and water-courses, other than water-courses at the passing of this Act mainly used as sewers, and emptying directly into the sea, or tidal waters which have not been determined to be streams within the meaning of this Act by such order as aforesaid." It is possible for this reason that Stirling has not been compelled to institute a sewage purification scheme.

The physical appearance of the Carron does not betoken any substantial improvement in the direction of purification, and indicates that trade pollution is being still poured into it.

In June, 1904, when an inspection was made of the river, the Medical Officer of Health reports "there was the usual evidence, in the way of white froth, of pollution from the paper works." Samples were taken from two of these works, one sample from one work, and two from the second. The following table shows, in brief, the total solids, etc., which these samples contained. I have marked them (*a*), (*b*), (*b*), the results being in grs. per gallon.

	(*a*)	(*b*)	(*b*)
Total Solids ...	42·84	135·8	164·36
Dissolved Solids ...	34·72	119·0	150·64
Suspended Solids ...	8·12	16·8	13·72
Carbonated Alkali ...	0·0	7·2	1·71

In the summer of 1902, samples from these and other works were taken, and may be added to the foregoing. The samples taken from the above works are marked as the above, and the others as (c).

	(*a*)	(*b*)	(*c*)
Total Solids ...	48·6	(1)* 168·50	(1) 28·01
Dissolved Solids..	26·04	93·48	18·96
Suspended Solids.	22·56	75·02	9·05
Total Solids ...	...	(2) × 284·26	(2) 42·01
Dissolved Solids..	...	222·60	25·69
Suspended Solids.	...	61·66	16·32
Total Solids ...	...	(3) 71·49	...
Dissolved Solids..	...	42·43	...
Suspended Solids.	...	29·06	...
Carbonated Alk. .	1·68	(1) 17·35	Nil.
Carbonated Alk. .	...	(2) 35·85	Nil.
Carbonated Alk. .	...	(3) 13·23	...
Free Alkali ...	Nil.	(1) 11·76	Nil.
	...	(2) 6·16	Nil.
	...	(3) 0·17	..
Colour	...	(1) Brown.	Opalescent.
	...	(2) White.	Opalescent.
Density	Small capital type read at 20 inches depth of column of fluid.	(1) Not read at 2 inches. (2) Do. (3) Not readable at 5 inches.	(1) Not readable at 3 inches. (2) Not readable at 15 inches.

Note.—* Signifies filtered effluent.
× Signifies unfiltered effluent.

These results show that the paper works are still polluting the river, and demand that more perfect filtration of the effluents should be made. The Carron is polluted also in its lower reaches, that is, within tidal waters, by the crude sewage of Falkirk burgh, and the effluents from the sewage tanks which deal with the sewage of Carronshore, Larbert, Stenhousemuir, and Carron. It is estimated that the sewage of about 25,000 persons finds its way into the river within these lower reaches. The Bonny is polluted from coal-washing operations, and from sewage of Bonnybridge, Dennyloanhead, Longcroft, and some mining villages.

COUNTY OF ROXBURGH.

The rivers of this county which deserve attention are the Teviot, the Jed, and the Tweed.

It cannot be said that these rivers are substantially different now from what they were in 1897. Perhaps they are not so grossly polluted as some of the streams in other counties, but they still receive the sewage of populous places on their banks or on the banks of their tributaries.

In 1894, I was asked to make an inspection of the Tweed, and of a tributary thereof, relative to an action which was raised by a riparian proprietor and a tenant of salmon fishings for the removal of pollution from the sewage and trade effluents of a burgh situated on the banks of the tributary. I found the tributary to be in a highly-polluted state, partly from sewage, partly from manurial refuse, and mainly, perhaps, from trade effluents, particularly dyes and wool-scouring refuse. Samples of the suspended matter from the river water after sedimentation microscopically betrayed marked evidences of sewage pollution. There were large numbers of vorticella, paramæcia, algæ, pupæ of insects, cotton fibres unstained, woollen and cotton fibres stained red, and others stained blue, particles of carbon, and miscellaneous vegetable débris. Many chemical analyses of the water of the tributary were made, which also indicated organic pollution. The water of the Tweed itself was found on inspection to be polluted from the tributary, the stones on its bottom being covered more or less thickly with sewage fungus. Enormous numbers of fresh-water molluscs were found in the track of the stream along which the current of the polluted tributary flowed. At a point about two miles below the confluence of tributary and Tweed, in deep pools in which sedimentation was apt to occur, I found deposits of sewage matter of a depth of from eighteen inches to two feet, which, when stirred, gave off foul odours. Fish, however, were rising freely to fly during my visits to these pools, indicating that the water of the Tweed was amply oxygenated, although somewhat foul. A settlement of the case was made out of court.

FURTHER PROCEDURE.

In my former paper on River Pollution in 1897, I remarked: "It is yet too soon to look for much result at the hands of County Councils [in the way of any well-defined or systematic attempt to cope with advancing pollution], however much energy they may have been, or may be, displaying in this direction: but on all hands there is a general complaint that, in reference to *public action*, the enactments at present in force are so hedged round with restrictions—in short, are so clumsy—that but little benefit must be looked for from action based upon it in the future." That opinion was founded on the fact that certain English Councils, in their efforts to enforce the Act, found it to be practically unworkable, and were compelled to go to Parliament for special legislation to enable them to overcome their difficulties. Thus, the Lancashire County Council obtained "The Mersey and Irwell Joint-Committee Act, 1892," and the Council of the West Riding of Yorkshire, the "West Riding of Yorkshire Rivers Act, 1894."

Despite, however, my somewhat gloomy prognostications, and the difficulties of these English Councils, it is most satisfactory to know, notwithstanding the inherent difficulties in the administration of the Acts, that the Lanarkshire County Council have surmounted them, and in the course of ten years have such a splendid record of work to show in this direction. The Medical Officer of Health, Dr Wilson, said in his letter to the Council when presenting his exhaustive report in 1903 on the subject of administration of these Acts in the County: "Prior to 1896, little, if any, action had been taken in Scotland under this statute, so that offenders were disposed to contest every point of procedure, and raise every objection the law might permit. . . . The Rivers Pollution Prevention Acts remained, until a comparatively recent date, a dead letter. This seems to have been partly due to a very general belief that the provisions of these Acts were unable to accomplish the objects intended; but the experience of this County has shown that this belief is unwarranted, and that the law is effective in compelling offenders to carry out preventive measures." It is only necessary to say in comment on the foregoing that this is largely due to the energy of Dr. Wilson and other officials, and to the public-spiritedness of his Council, while their action and its results stand as a serious indictment against those Councils in other counties who have remained almost entirely, if not wholly, inactive in their administration of the Acts.

One of the chief obstacles experienced by the English Councils in enforcing the provisions of the Acts was the delay experienced and the time wasted in securing the consent of the Local Government Board for prosecution. In the Yorkshire Act, power was given to the local Joint-Committee to initiate action against polluters without the consent of the Local Government Board, except with reference to pollutions from manufacturing processes, and, even in that case, the offender is only to be entitled to receive one month's notice instead of two months as in the Act of 1876. Further, under this same Act for Yorkshire rivers, the Rivers Board may prosecute offences and recover penalties before a Court of summary jurisdiction, all penalties recovered are to be put to the credit of the Board, and costs of the proceedings are to be in the direction of the Court. With reference to administration, any officer of that Board, on showing his written authority, may enter any lands or works as he may think fit for the purposes of his enquiry, may take samples of effluents therein, but in triplicate, one of these samples to be left with the owner of the works.

In order that a more effective survey of rivers or watersheds may be possible—and particularly where, in any case, these rivers or watersheds happen to be situate within the jurisdiction of different authorities competent to take action under the Acts—it will be obvious that some arrangement for concerted action is necessary. In the Rivers Pollution Act of 1876, Section 9, powers to enforce the Act by the Conservancy Board constituted under the Lee Conservancy Act of 1868 were introduced. In 1892 a Joint Committee, composed of members of the County Councils and county Boroughs of Bradford, Halifax, Huddersfield, Leeds and Sheffield, within the West Riding of Yorkshire, was formed by a provisional order of the Local Government Board, in order that uniform and effective action might be secured. By Section 4 of this Act, the title of "joint committee" was changed to "The West Riding of Yorkshire Rivers Board," referred to in the Act as "The Rivers Board." But up till the present time, no such Committee or Board has ever been constituted in Scotland, probably either because the time was not ripe, or because a forward movement for the purification of our rivers was not sufficiently far advanced or sufficiently supported.

The time is now nearly ripe, however, for such a movement in respect of certain districts of Scotland. It is difficult to suppose that, in view of the expenditure of such enormous sums of money for purification of the Clyde within the city of Glasgow, the Corporation of Glasgow will longer tolerate the continuance of existent pollution in contributary streams. It is only necessary to ask the question to supply an answer: What good would be derived from such expenditure in establishing sewerage and purification works if and so long as pollution is to be permitted by another local authority? To put the question in concrete form: What improvement might be expected in the condition of the Clyde within the harbour of Glasgow if the polluted Kelvin from another local authority is to continue to pour its polluted contents into the very centre of the harbour itself? or again, if the Cart in its polluted state from Renfrewshire is to continue to enter the river in that unpurified condition? All this points to concerted common action on the part of all local authorities who are, or ought to be, concerned in the purity of the streams within the same watershed.

Fortunately, it is possible for such common action to be taken. In the Local Government (Scotland) Act, 1899, Section 55, Sub-section 3, the following provision has been made:—"The Secretary for Scotland, by provisional order made on the application of any of the councils of any of the counties and burghs concerned [to enforce the provisions of the Rivers Pollution Prevention Act, 1876], may constitute a joint committee or other body representing all the counties and burghs through or by which a river, or any tributary thereof, passes, and may confer on such committee or body all the powers of a sanitary authority under the Rivers Pollution Prevention Act, 1876, or such of them as may be specified in the order, and the order may contain such provisions respecting the constitution and proceedings of the said committee or body as may seem proper, and may provide for the payment of the expenses of such committee or body by the counties or burghs represented by it, and for the audit of the accounts of such committee or body, and their officers." Such a provision as the foregoing will require, in my opinion, to be invoked if the City of Glasgow and the County Council of Lanark are to derive the full value of their efforts to purify the Clyde and its contributary streams. Moreover, experience of the effective operations of such joint-committees has demonstrated that in this way the most effective action and results are likely to be secured. The committees or river or conservancy boards, as they are called, under the Acts pertaining to the English authorities already named, have been able to show progressive improvement in the purity of the rivers which they are to conserve.

If we assume that such provision as the foregoing, viz., the formation of a joint-committee to take charge of the rivers and streams within the Clyde watershed, is the course which ought to be taken in the near future, an attempt might now be made to forecast how best it might be accomplished, and what action in the future such a committee or board would have to undertake.

First, with respect to Constitution of the Board.—The section of the Local Government Act relative to the formation of such a committee or body, already quoted, defines the limits of those who are entitled to act upon such a committee, viz.:—"Those representing all the counties and burghs through or by which a river, or any specified portion of a river, or any tributary thereof, passes." Thus, in this case, it would be necessary to have representatives from (*a*) County Council of Lanarkshire, (*b*) Burgh of Lanark, (*c*) Burgh of Hamilton, (*d*) Burgh of Wishaw, (*e*) Burgh of Motherwell, (*f*) Burgh of Coatbridge, (*g*) Burgh of Airdrie, and, in addition to (*h*) representatives from the City of Glasgow, there would have to be included (*i*) representatives from the County Council of Dumbarton, (*j*) the County Council of Renfrew, and (*k*) the Burgh of Paisley. It would be unwise to forecast the numbers of representatives from each of these respective bodies which should be apportioned. But such representation would include all the local authorities embraced within the provision of the subsection of the Act referred to. It will be observed that the Burgh of Rutherglen has been omitted from the list. The reason for this is that, by arrangement with the City of Glasgow, all the sewage of that burgh is taken into the Glasgow system of sewerage, and is incorporated in the South-side Sewage Scheme. That, however, may be left an open question.

Should such a provisional order be applied for by the City of Glasgow on the lines laid down by the Local Government Act, the question arises whether, in the application, powers of the extent given in the English County Acts should not be asked. The conditions which demanded their being sought for in these counties exist also here, and are calculated to secure better enforcement of the provisions of the Pollution Acts.

Second, with respect to Administration of the Acts by such a Committee or Board.—From what has been said respecting the need for inspection by special officers appointed by the Lanarkshire Council, it is obvious that officers for this purpose would fall to be appointed by the new Board, in order to secure the detection not merely of new pollutions, but also to see that remedial or preventive measures already in operation are being worked properly. The institution of remedial or preventive measures or works against pollution is no guarantee that pollution will not take place after their institution. Experience has shown that the working of such is not always maintained at their original level of efficiency. Moreover, in certain operations particularly, such as coal-washing and other trade processes, constant observation is necessary to prevent lapse of operation or efficiency of purification. There is no need to exaggerate the difficulty in detecting the pollution. Dealing with this subject of coal-washing in his report, the medical officer of health of Lanarkshire informs us as follows:—"There is, no doubt, on the part of the employees at some collieries, wilful negligence or something worse. The inspector visits, he finds the washings being properly treated, but on examining the outfall and the streams below there is abundant evidence that serious pollution has occurred since his previous visit. The manager is appealed to, but a satisfactory explanation is seldom obtained. Inspections are then arranged for at unusual hours, and on one occasion an all-night inspection was carried out, when, at about two o'clock in the morning, the inspectors who were waiting down the stream found it being seriously polluted. On proceeding to the colliery, they found the sluice of the settling pond raised, and the contents of the pond entering the stream without any treatment whatever. The question may be asked as to what should be done to make the detection of offences more simple, and the provision of fines or penalties has been suggested." From my own experience, I have observed with what remarkable coincidence accidents (?) occurred in such operations as the above at collieries while floods were on the river into which the purified effluent only should flow. Regarding penalties, the English County Acts contain such provisions. The only penalty falling to be paid according to the terms of the Rivers Pollution Act is that where any person makes default in complying with any requirement of an order of Court, in which case the Court may order such person to pay to the person complaining, or such other person as the Court may direct, a sum not exceeding fifty pounds a day for every day which he is in default. The absence of penalties is undoubtedly a defect in the Act, as it gives no power of control to the authority who is charged with administration of the Acts over those who repeatedly pollute, other than that of interdict. It would certainly be a wholesome provision that such polluters should be faced with the likelihood of the award of penalties. In the English County Acts, penalties may be recovered in a summary manner before a court against offenders. Should such a Board as that now under discussion be formed for the Clyde, it would be wise to ask for such powers.

Another important matter is that regarding the taking of samples from sources of pollution. No provision is made in the Acts for this, and it would seem as if the County Council officers have to give notice to works, etc., when they desire to take samples. The Medical Officer of Health of Dumbartonshire, Dr M'Vail, in his report concerning samples taken from works which pollute the the Leven (1904, p. 49), remarks as follows on this point:—"Inspectors should have a general right of entry without previous notice, and it should be understood that an inspector may enter any of the works at any time for this purpose." Where recurrent pollutions are liable to happen from trade processes, it is only human nature to expect that the objects of the visits of the inspectors may be anticipated in the direction of making the effluents as good as possible on these occasions.

Moreover, it would be necessary that a register should be kept of all the known sources of pollution within the river area, in order that inspection may be carried through systematically. For this purpose, it might be well to copy some of the provisions of the Alkali Acts, in which such exist for the keeping of a register. Those in charge of such a register would thus be kept in touch with any new sources of pollution, from sewage or trade effluents, where new populations or new works arise.

Scottish Mosses. By JAMES STIRTON, M.D., F.L.S.

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I HAVE, in the first place, to record the discovery of fruiting specimens of *Ulota phyllantha* and *Scotica* from three localities in the neighbourhood of Arisaig. How many capsules of each have been secured cannot be reckoned at present—certainly 20 in the aggregate. As is well-known, *U. phyllantha* is found in great profusion in the West of Scotland, including the Outer Hebrides where trees can be got to grow, also in Wales and Ireland, Western and Northern Europe, and throughout extensive tracts in Canada and North America, and yet I should say not more than a dozen capsules have ever been found, and not more than half that number in good condition. As in other instances, fruit has only been found where *U. Bruchii*, in a fertile state, grew intermingled with it. The fruit of *U. Bruchii* was ripe in September, but the capsules of the other two must have ripened three months previously. What influence the antheridia of *U. Bruchii* could have had in fructifying the other two it is impossible to say, but the probability is that there was a determining influence of some sort.

The fruit of *U. Scotica* is the longer of the two, and the long, slender neck runs far down the seta. In one instance of *U. Scotica* eight pale pinkish, short, broad teeth were seen, with eight shorter cilia between; the teeth were also seen to split into two distinct parts.

I have not yet ventured to separate the two kinds of capsules from the mixed tufts, for the reason that the fructified stems have leaves, for the most part, with only rudimentary propagula, accordingly the minute structure of the leaf requires examination for adequate determination.

Along the main road at Arisaig grows a *Grimmia* on stones which, in wet weather, has a peculiar glossy or silky sheen, such as I have not seen in any of the species of this perplexing genus.

The flat tufts are often extended continuously from two to six inches, but the strange peculiarity about it is its rapidity of growth. I have watched a tuft of *Grimmia Stirtoni* (Sch.) near Killin from year to year for the purpose of getting fruit, showing scarcely any difference in the size of the button-like patches. On the contrary, this moss, during three months, often extended from two inches to nearly four, and what is more, minute new patches became quickly visible in the near neighbourhood. Moreover, in 1904, this moss could be detected for not more than half a mile, while in 1906 it could be traced for nearly double that distance. It never fruits. By what means was it propagated so quickly? This puzzled me, until in the beginning of September, during rainy weather, propagula were seen in abundance at the apices of stems, and generally attached to leaves near their bases as well as to the stems themselves. These propagula are quite unique in character. They are globular, yellow, then reddish-brown, simple, or at times 1-septate, with granular contents, in clusters or in short chains and large, ·03-·038 mm. diam. A question arises whence the origin of this moss, or, rather, whence the origin of these germinating cells. This question is rendered more difficult of solution from the fact that the moss grows nowhere else in the district, and I have not observed it in any of my rambles elsewhere.

Grimmia polita. Tufts extended, of a yellowish green colour, stems strong, simple, or not infrequently somewhat fastigiately branched above; leaf a little crisped when dry, laxly spreading when wet or cohering in little bundles during wet weather, ovate lanceolate ocuminate, terminating in a long, nearly smooth hair; nerve strong, ·065 mm. broad near base, scarcely narrowing upwards for more than the lower half, turning red, of rather dense structure within, but on the very prominent convex back a row of close cells, evidently a continuation of the paginal cells, as chlorophyll was detected in them, of another central row of larger cells, and in front, irregularly placed smaller cells; central basal cells of the leaf; long, narrow, granular, ·038-·055 by ·005-·008 mm.; outwards broader and shorter, with three to five short perpendicular rows at basal margin of nearly hyaline, oblong cells, about ·032 by ·01 mm.; upwards, cells gradually denser, until they are ultimately quite opaque and densely granular, variable in shape and larger than usual, ·008-·011 mm. diam.; margin recurved for nearly two-thirds up from base, and what is unusual, more broadly recurved in the middle than below; pagina unistratose below, soon one marginal transverse couple of cells seen, then two such, and near apex very often three close couples seen. Accordingly all the cells, except those of the small basal marginal group, are more or less densely granular; besides, in wet weather, minute points, like stereïds, are seen everywhere between and even on the cells.

This moss is evidently allied to *G. trichophylla* (Grev.), but is quite distinct from it; besides, the latter, which fruits freely, was not detected in the district. Indeed, this part of the West Coast is rather deficient in species of this genus.

At Glenfinnan, a railway station half-way between Arisaig and Fort-William, was discovered a peculiar little moss.

Oligotrichum exiguum. In lax tufts, green above, red below; stems simple, very slender, slightly undulating, from a quarter to half-an-inch long; pale, then red; leaves laxly disposed around stem, incurved when dry, still a little incurved when wet, upper green, lower red, slightly sheathing, oblong, apex deeply cucullate with the nerve bent nearly at right angles, rendered sharpish by means of a longish apical cell; nerve in lowest fourth free of lamellæ; above, with from six to eight or nine lamellæ, long, slender, composed of from seven to ten bluntly quadrate cells in single series, apical cell a little longer; lamellæ nearly as broad as the breadth of pagina of either side, nerve imperfectly or interruptedly (two to three) lamellate above; cells at central base oblong, ·02 by ·011 mm., only a few such, the rest upwards, nearly bluntly square, but variable, ·012-·018 mm., across, somewhat smaller near apex; pagina unistratose, non-papillose; margin entire but incurved above, with one or two teeth near apex. Barren.

There is another *Oligotrichum* from Connel Ferry, with stems from a half to one inch in height, but these instead of being simple as they are always, have two to five fastigiate branches arising from a common stock situated about half way up the stems. The apex of the leaf is, besides, slightly incurved.

Let this form meanwhile be called *O. hercynicum var. fastigiatum.*

There grows on a wide but rather shallow basin opening on the sea to the north of Arisaig, a minute moss in very dense, and in two instances, very wide, continuous flat tufts, from five to eight inches in diameter. As many as six separate patches have been noticed, those furthest apart not more than two miles from each other. As I cannot identify this moss with any other, and as, moreover, it is very constant to its characters, I think it right to describe it although it is barren.

Pohlia tenerrima. In very dense, generally large tufts of a beautiful green colour above, pale or pale yellow below; stems a quarter to one-third of an inch long, generally simple, rarely divided, very slender; leaves laxly disposed around the stem, very tender as well as small, on an average ·7 by ·27 mm. at greatest breadth, erecto-patent when moist, straight and more upright when dry, but pagina shrivelling somewhat, ovate lanceolate scarcely acuminate; nerve slender, pale then yellowish, about ·04 mm wide near base, tapering, and either very slightly excurrent or vanishing in the acute apex, where it is rather indefinite; margin plane, entire or faintly serrated near apex; cells at central base closely oblong, ·028-·04 by ·008-·011 mm., outwards shorter and at margin with one or two rows of quadrate cells, ·013-·018 by ·01-·012 mm., upwards cells narrower and rhomboid, ·027-·032 by ·007 mm. On peaty soil mixed with sand.

The areolation points to association with *Pohlia.* The leaves are wonderfully uniform in size and shape throughout the whole series of tufts, and only show a little smaller and shorter near base of stem, but lengthen very little towards its summit. The stems, although slender are tenacious, as the older may be traced continuously down through the soil to a depth of half an inch.

Barbula limosella. Tufts very compact, often extended, forming patches of a vivid green colour above, reddish below as well as radiculose; stems very slender, simple for much the greater part, occasionally bifurcate, one third of an inch long or less; leaves curled and crisped when dry, widely spreading when moist, with the upper fourth strongly recurved or squarrose, especially the short extended part of nerve; base hyaline as in *B. limosa*; upper cells large, distinct, hexagonal, or merely rounded, ·009-·014 mm. across, without papillæ; indeed, scarcely any papillæ detected throughout the leaf which has a blunt apex, as in *Trich. brachydontium*, and pagina frequently ending abruptly and unequally, but the nerve in this is certainly extended. At the mouth of the basin, near Arisaig, on muddy soil mixed with sand, a little within high-water mark of spring tides.

In this broad, shallow basin, through which a sluggish stream meanders, and which opens out like a trumpet on the sea, where its breadth is two miles, are found five mosses belonging to a closely allied group, viz., *Barbula tortuosa*; a large form of *B. nitida*, as well as its usual condition; *B. limosa* (Annals, April 1905), and *B. limosella*; lastly, *B. exiquella*, referred to below. The upper cells of *B. limosa* are obscure from the presence of papillæ, and minute, ·005-8 mm. across. Accordingly the upper cells of *B. limosella* are nearly four times as large as those of *B. limosa*. *B. limosella* is the most slender of the four as well as the most compactly tufted.

Schistidium nodulosum. Laxly tufted, of a dark green above, reddish below; stems simple or dichotomously branched, about half an inch in length; leaves rather closely arranged, imbricated when dry, spreading a little when wet, ovate lanceolate slightly acuminate, contracted at base; nerve strong, thick, bulging much behind, reddish at base, ·06 mm. broad, slightly broader above, and near apex still ·045 mm. broad, strongly nodulose behind and at sides, nodules ·004-6 mm. high, rounded at apex, sparsely nodulose behind, also on margin near apex, as well as on the lower part of the hyaline hair which is besides crisped or spirally twisted throughout, and nearly half the length of pagina; margin strongly recurved near base, almost spirally so for two thirds upwards, plane thereafter; cells at central base bluntly oblong, separate, ·024-·04 by ·007-9 mm., outwards shorter and slightly constricted with three or four marginal rows of roundish or irregular cells, ·01-·013 by ·007-9 mm., upwards at first slightly constricted then roundish, separate, ·006-9 mm. across; pagina below thin, thicker upwards, unistratose at first, then on margin one transverse couple of cells, soon two such, and further up often three, with not infrequently one detached couple nearer nerve. Arisaig and on Ben Lawers, 1867. Barren in both instances. I described in the Annals for April, 1900, a corresponding nodular condition of *Schist. maritimum*, but the other peculiarities in the present moss warrant, in my opinion, specific distinction.

Throughout a series of years I have picked up from time to time a moss on open moors more especially, which I had rather rashly identified with *Breutelia arcuata*. Last year the two were found in close proximity when the contrast between the two was rendered much more manifest. In the absence of fruit I have, meanwhile at least, inserted the present one under the genus *Bartramia*.

Bartramia subvirella. In extended rather dense patches of a yellowish-green colour; stems for the greater part dichotomously branched with not infrequently very short branchlets near the apex; leaves closely arranged round stems, slightly spreading and straight both in a wet and dry state, not clasping (as in *Breutelia*), rather broadly and roundly ovate lanceolate shortly acuminate, only slightly sulcate near base, plane and smooth above, thin and translucent, very fragile in upper fourth; nerve narrow, ·04 mm. near base, tapering and vanishing considerably below apex, margin rather broadly reflexed in lower half, serrate throughout, but more sharply so above; central basal cells much shorter and a little broader than those of *Breutelia*, bluntly cylindrical, hyaline, ·025-·035 by ·005-·0065 mm., becoming narrower and longer upwards, ·032-·045 by ·004-5 mm., with papillæ at the lower extremities of cells; at alar base a longish group of bluntly oblong cells, coloured red below, ·016-·025 by ·01-·013 mm. It is not necessary to indicate further the differences between the two mosses as they are manifest enough.

The next moss has been familiar to me for several years, more especially in the neighbourhood of Glasgow. It was got throughout November of last year in perfect fruit. It differs from *Hypnum cupressiforme* in several important particulars.

Hypnum teichophilum. Tufts large, dark-green, prostrate; stems stout, irregularly branched; leaves large, not divaricately arranged on stem, but regularly imbricated on its upper aspect and falcate downward, convex, somewhat decurrent on stem; margin plane except in lowest fifth, where it is often seen slightly reflexed, entire, except in uppermost fourth, where it is slightly serrulated; nerveless or obsotetely 2-nerved just at base; alar basal spaces well defined, nearly square or slightly oblong, composed of five to eight perpendicular rows, each having five to seven or eight cells, cells square (or slightly oblong), with thickish walls, becoming reddish, but contents remaining colourless or only very sparingly granular, ·018-·027 by ·014-·021 mm.; cell above long, narrowly acicular with sharply-pointed extremities, ·06-·085 by ·003-·0045 mm., a little broader near base; capsule on a long, reddish, strong seta, oblong, curved, brown; lid large, conical, terminating in a slender, shortish acumen. Accordingly this moss differs from any form of *H. cupressiforme* in its cell formation, both alar and general, in the disposition of the leaves round the stem, in the seta, capsule, and lid.

Dr Braithewaite, in his work on British mosses, states that the alar cells in *H. cupressiforme* are typically square in shape. Such is not the case. They are small, oval, and, in much the larger proportion, reddish-yellow as well as darkly granular.

There is still another moss scattered here and there throughout the district of Arisaig, in crevices of rocks, but, in two instances, on stones slightly covered with earth. It is near *Dicranum montanum*, but differs, in the habitat, in the leaves not being papillose, and their apices quite entire and much narrower, etc.

Dicranum leiophyllum. Tufts large, rather lax, of a dark-green colour above, brown beneath, slightly radiculose; stems simple or bifurcate, about half an inch or more long; leaves ovate lanceolate, narrowly subulate, much curled when dry, laxly spreading when moist, slightly clasping the stems where they are broader, but rather quickly narrowing into the long subulate upper portion which is quite entire and a little rounded at apex, but narrow, about ·03 mm. broad, not papillose, margin plane, entire, but a little incurved upwards; nerve, ·065-·085 mm. broad near base, tapering and vanishing below apex; auricles well developed, cells large colourless at first, then with thick, brownish walls, oblong or oblongo-hexagonal, ·03-·045 by ·013-·018 mm., central basal cells granular, narrow, cylindrical, ·04-·06 by ·0045-·006 mm., outwards shorter, broader until near margin much the same as those just above, upwards gradually shortening into the dense, distinctly separate, opaque, quadrate or rounded, granular cells above, ·007-·01 mm. across, but near margin always smaller, ·005-·008 mm.; cells found quite at apex; seta (often two from one perichætium), pale, then reddish, long, strong; capsule erect, oblong, brown; teeth dicranoid but broken; lid (in young capsules) long, subulate above, not much shorter than capsule. The fruit is either that of the previous year, or too young for examination.

The upper cells of the leaf have a distinct resemblance to those of *Amphoridium Mougeotii* in their peculiar opacity, in being faintly striated longitudinally, and in showing slender connecting tubes with neighbouring cells, especially in a vertical direction.

I have seen the same peculiarities in several other mosses, but more particularly in *Bartramia Oederi* (Sw.).

Trichostomum episemum. Tufts rather dense, having much the appearance of those of *Tr. brachydontium*; stems strong, about one inch in length, leaves oblong, reflexed when wet, obtuse and rounded at the apex as in *Tr. litorale*; nerve strong, pale then red, ·085-·1 mm. broad near base, tapering and excurrent in a short stump, margin plane crenulated above from projecting cells as well as papillose; cells at base large, oblongo-hexagonal, with thin walls, but merely oblong nearer the margin, all hyaline, ·04-·06 by ·01-·013 mm.; above, at first shorter and oblong, passing gradually into the obscure, large, upper, generally hexagonal, but often bluntly quadrate cells, ·009-·014 mm. diam., densely and minutely papillose back and front. Connel Ferry, 1905.

According to the description by Dr Braithwaite, Vol. I. pp. 243, 246, this cannot be either *T. angustifolium* or *T. lutescens* (Lindb.).

In 1903, Mr D. Haggart sent me from Glen Lochy, Killin, a *Rhacomitrium* which, owing to the papillosity of the leaves, and long teeth of the peristome, nearly as long as the capsule, was referred to *R. canescens.* The leaves, however, are quite muticous, and even slightly rounded as well as slightly hollow at apex. But what is most remarkable is the areolation of the leaf, which is that of *R. heterostichum*, viz., in upper half the cells are green-chlorophyllose, at first short and constricted in the middle, while nearer the apex they are quadrate, ·007-·01 mm. across.

I think it right to call attention to this moss. Meanwhile, it may be named *R. consocians.*

Another *Rhacomitrium* has similar peculiarities. It resembles in habit what I have described in the "Annals" for April 1902, as *R. amblyphyllum.* The two have in common blunt apices to the leaves, where the breadth at the junction of hair with pagina varies from ·12 to ·25 mm., but in this the areolation is entirely that of *R. microcarpum*, inasmuch as the cells near and at apex are sinuose, ·014-·025 by ·005-7 mm. Let this also be named *R. divergens.*

This moss has been discovered in many places in the West of Scotland and Western Islands.

As I have said in a previous paper, I am anxious to call attention to such peculiarities of structure, inasmuch as they seem to indicate departures from the usual conditions of organisation, which may have important bearings on the life-history of the plants themselves.

The genera which I have studied more closely as showing stronger tendencies to such departures from the normal, are—*Campylopus*, *Dicranum*, *Grimmia*, and the near congener of the last, *Rhaconitrium.*

There was also found south of Arisaig on open moors, generally near rivulets, but not in woods, *Hypnum corrugatulum*, described in the "Annals" for April, 1897, under *H. triquetrum.* On two occasions small quantities of *Barbula exiguella*, also described in the "Annals" for April, 1897, were picked up but, as in Orkney, only young setae were seen. In my older collections made during the *sixties* on the Breadalbane Ranges, I have come across *Barbula icmadophila* (Sch.) from near the base of King's Seat, Killin, and *Hypnum Canariense* at the base of Ben Lawers, near the Inn.

The Training of Youth: Supervision of Lads from their Fourteenth till their Seventeenth Year. By ALEXANDER SCOTT, M.D., Certifying Factory Surgeon, Glasgow.

[Read before the Society, 10th April, 1907.]

EDUCATION is practically compulsory in this country from the fifth till the fourteenth year, after which School Boards lose their power over our boys, even though they may provide continuation classes. Attendance at these classes can only be enforced by parents or guardians, and the battle of life is in many cases so exacting that the wage earning ability is to them the chief concern. It is true that, according to the Factory Act, no young person can be employed in a factory until he be examined by the Certifying Surgeon as to his health and fitness, and up to the age of eighteen he works only under certain conditions; but while his physical well-being is thus safeguarded, the continued training of his mental powers is entirely neglected. Every year enormous sums of money are spent on the education of our children, and subjects are now part of the elementary school curriculum which were unheard of by the pupils' parents. Yet it is a deplorable fact that a large amount of that money is absolutely wasted, inasmuch as after the fourteenth year of his age the boy is sent out into the industrial world, his educational training or equipment for trade or commerce dependent upon chance, and, it may be, entirely unguarded and uncared for, either morally or intellectually. The years between fourteen and sixteen have in fact become known as the great years of forgetting and undoing, instead of being treated as perhaps the most important for the formation of character and the assimilation of the knowledge which has been acquired. In these years the body grows rapidly, the various organs become perfectly developed, but this growth is more corporeal than intellectual. That there should be proper care of this physical growth is certainly desirable, and one must feel a degree of satisfaction in the fact that the state has instituted, to some extent, a system of public supervision over the health of young people in certain spheres of industry. Even this medical supervision of the physical fitness of our boys is, however, only limited. Last year, for example, a total of between 4000 and 5000 boys left school in this city, and of these only a small percentage was examined by the Certifying Surgeon. As giving an indication of how many of these boys, either of their own free will or to gratify their parents, continued to attend day or evening schools, it is instructive and interesting to note that at their opening last autumn only 1152 at the age of fourteen, and 857 at fifteen enrolled their names.

Now the law allows a boy to leave school—that is to get free from all compulsory educational training—when he has attained the age of fourteen, and since he can rarely be apprenticed to almost any trade until he has reached his sixteenth year, it follows that, from the age of fourteen till the age of sixteen, he is left to engage in any desultory occupation which may crop up, and, as a rule, that occupation, while providing perhaps fair remuneration, calls for neither education nor training. This appears to be the crux of the whole question. The stream of knowledge is abruptly stemmed at the age of fourteen, so that the two, perhaps most important, years of the lad's life, so far as his educational equipment is concerned, are entirely neglected or wasted.

How are we, then, to keep in touch with youths from fourteen to sixteen? How are we to continue the process, begun in the elementary schools, of fitting them to take their proper place in the battle of life? How may we equip them to raise themselves and raise our nation in the ever keen and never-ending struggle for supremacy in trade and commerce? What is the duty of the State regarding their prospects, and what can social influence do to advise and assist parents in their responsibilities in this connection, or to offer a kindly helping hand to those who have no one to guide them and are left to the force of circumstance, or to follow the bent of a will which knows no discipline? The State, by allowing a boy to get free from compulsory educational influence at the age of fourteen, appears to be satisfied that it has sufficiently discharged its duty: it is assumed that on leaving the Board School his education is for ordinary practical purposes complete. And yet from time to time the columns of our daily papers are crowded with letters from merchants and others complaining, not without cause, of schoolboy shortcomings and deficiencies in their general education; and this is not to be wondered at when we consider the hurry and fast driving too often apparent in the elementary schools, so much so that in recent years leading has given place to driving, and the boy abandons his school life in disgust, leaving just at the time when his mind should be maturing into a keener interest for study, and beginning to digest what he has learned. Development of mind and body demand, that for the next two or three years he should have healthy employment during the day with instruction at school for two evenings weekly during the session, so as to provide change of occupation, to inculcate habits of industry, and thus insure that he may have the opportunity of acquiring a disciplined and well-trained mind. It is manifestly absurd to suppose that a boy, after running wild for two years, will settle down to study when he becomes an apprentice.

Other countries, notably our chief commercial rivals, Germany and the United States, are bestirring themselves in this direction. In Germany everything scholastic is under the care of the State, ruled by the State, and entirely directed by the State, while compulsory attendance is enforced between the sixth and fourteenth years. Notwithstanding this, education seems to be no more perfect in their elementary schools than it is in ours, if we are to rely upon an independent report given by an American Commissioner. He says:—"Many boys in Germany leave the common schools before they have attained the end they have in view. They cannot express their own thoughts distinctly and intelligently, correctly understand the expression of the thoughts of others, or give a quick and correct solution to a simple arithmetical problem either mentally or in writing.. These acquirements are indispensable, however, to the mechanic as well as to the farmer to carry on his trade or follow his pursuit with advantage, and to protect himself again against losses."

This report resembles the complaint with which we are acquainted in our daily newspapers, and it proves to us that, although their schools are more intimately controlled by the State than ours, their education is not superior in any way to our own. Boys at a certain age, therefore, start with equal advantages in either country. But the career of the German boy is not lost sight of after school days; for there the police, acting as school wardens, enforce compulsory education of apprentices of all trades till the age of sixteen is reached. This supervision is by no means perfunctory, for the names having been received from employers, each apprentice gets a card on which his attendances are registered by the teacher of his trade, which card must be produced on demand by the police, and, in the event of the attendances being irregular, a prosecution follows. The Germans also, at great expense, maintain evening schools for agriculturists during the winter months, and in some districts these schools are very popular.

From America there is not much to learn. In some States compulsory attendance at schools is enforced from the eighth till the fourteenth, in others from the eighth till the sixteenth year; but the law appears to be more honoured in the breach than in the observance, inasmuch as one-half, in some cases as many as three-fourths, leave school before they reach their twelfth year. For some time, however, they have been beginning to realise the importance of technical education, and a law has been passed which enacts that every township of a certain population must maintain what is known as an Evening High School, the aim and scope of which are somewhat similar to our own Continuation Technical Classes.

In no country has technical education so immensely improved the science of agriculture as in Denmark. This has been so patent to the Danes that apprentices are encouraged by their masters to attend both day and evening classes for three months in the year when work is slack.

Regarding the future of the youth of these different countries I have no definite information, and even with respect to our own country I have unfortunately been able to collect statistics only in a limited number of trades, but these, I think, are reliable and suggestive. These countries appear to be grappling with that same aspect of the problem as presents the greatest difficulty to us here, namely, how to preserve in our youth continuity of intellectual training after he has been let loose from the elementary school. To get him transferred directly from school to a trade which calls forth the exercise of thought as well as the mere muscular manipulation of tools seems, to a certain extent, to answer the purpose. But even here, as I shall endeavour presently to show, there is a certain laxity in the control of apprentices, leading to regrettable results. Meantime I would pursue consideration of that large proportion who are allowed (perhaps I should say compelled) to accept that meaner form of employment, the discharge of which requires only physical fitness and the smallest intellectual attainments. The boy, as a rule, is only too pleased to get entirely freed from the restraint and forceful training of the school. He somehow rejoices in this period of what we might call barbaric freedom, and seldom of his own impulse will he return to the schools of mental activity. It may be, as I have already indicated, that the methods of tuition adopted in our schools are largely to blame for this. It may be that we rely too much upon driving the scholar and too little in drawing out his sympathy for the subjects under consideration. In a word, it may be that, in our hurry and eagerness to produce mechanical and commercial experts, we fail in most cases to go deep enough, to awaken in the boy that reasoning or thinking interest, which, for the remainder of his life, will draw him with affectionate desire to drink even deeper at the wells of knowledge.

But however that may be, we manifestly cannot allow this distaste for study, or anything else, to carry him into a period of drifting such as I have indicated. The stream of knowledge, the process of mental discipline, must not stop when he leaves the day-school. It is unfair to the boy, and it is a source of trouble and expense to the country. A connecting scheme of study and training must be provided, and this, I think, has been happily projected by Mrs Ogilvie Gordon, D.Sc., of Aberdeen. Mrs Gordon advocates the establishment in all large cities of a Central Information Bureau to which boys and girls could apply for full particulars and guidance as to continuation and technical classes and trade apprenticeships. Parents and guardians would he advised regarding the fitness of their charges, and informed as to the wages and hours of the various trades, also as to the improved prospects of promotion for those who took advantage of technical training. In the same way the Advisory Board of this Bureau would be in touch with local employers of labour and merchants. She expresses the opinion that "ten years of ardent pioneer work of supervision would make a very great difference, tending to consolidate some satisfactory system of national and local scholarships, grants, and Board management, so that in time matters might move more automatically."

As I have already said, German and American boys are compelled by law to attend continuation classes, and we are promised in our new Education Act legislation on the same lines. But much would still require to be done. My idea would be that, in order, not only to prevent the possible ruin of these young persons who may be engaged in unskilled employment, but to make the most of our national resource of brain and muscle, the State should make more elaborate arrangements, and compel them to embrace the opportunity of taking evening classes at which they would learn the theory of a trade, in the hope and with the prospect of subsequently being employed as an ordinary wage-earning member of that trade. No doubt the assumption will be advanced that bodily toil by day and mental effort in the evening might, in some cases, endanger the health of a youth, and so in this connection also we are brought face to face with the need for extended medical supervision. As, however, School Boards have recognised this need, and are on the eve of appointing medical officers, there is, I think, little cause for concern in that direction. Personally, I foresee a much more weighty objection, which is, by means of these evening compulsory schools at which the theory of trades will be taught, we shall be instituting a new source of supply of trade apprentices, while the labour market promises no increase in its demands for them. It may be urged, therefore, that in the present state of the British labour market this proposed Educational Bureau could hold out only a false hope of reward to the youth for his nightly assiduity in study. The Trades Unions generally control the number of apprentices, who appear to be plentifully enough already, and if there is going to be no increase in the demand it will be no solution of the problem to increase the supply. On the register of one engineering firm in the city there are at the present moment, I am told, no fewer than forty-seven applicants for apprenticeship.

In answer to this objection let me remind you that all brains are not developed alike, and if these agencies to which I refer were able to point out the incapacity of any candidate before it was too late, they would be the means of preventing many a wreck. To this extent such institutions would be helpful. But our chief concern is that no one, not even the weakest, must go to the wall. Society demands and Statesmanship must seek a solution more humane and more economical than such a waste of the nation's resources. If, then, we cannot find a market for this more highly educated article which we produce in our own country, something must be done to find him a home and a useful occupation for his energies in our Colonies. Nearly forty years ago James Anthony Froude, contemplating the congested state of the British Isles, said:—"We want land on which to plant English families, where they may thrive and multiply, without ceasing to be Englishmen." To-day the need for larger territory for British families is greater, not less, but it happens as a fortunate circumstance that with a growing need for land as a habitation, there has been on the part of our colonies an, if possible, more urgent need for families. Why, then, should there not be an exchange of benefits between our Colonies and ourselves? Might they not arrange for the cheap transference of our surplus, but none the less valuable working families? If, as is likely, the agriculturist was more in demand by the Colonies than the ordinary artizan, then the science of agriculture would be as easy for us to teach as the theory of a mechanical trade.

However baneful the results may be that arise from the decline of apprenticeships in trades and the effects of piece work, they are not to be compared with those arising from the irregular life which a boy may lead on leaving the day-school. Here the leakage is most disastrous, and the appeal for supervision by our educational authorities and social agencies becomes most urgent.[1]

The necessitous condition of parents, in many cases, compels boys to find that kind of employment which has all its attraction in the good wages of the present. The very idea of being able to earn a comparatively decent wage for a boy, and of being a valuable help to his home, has usually the effect—account for it as we may—of making him too soon a man in his own estimation, a man with a good deal of arrogance and insolence, and impressed with a precocious affectation of the manly vices. In his employment there may be little brain power needed, and perfect efficiency may be reached in a month, perhaps less, thus rendering his daily toil absolutely devoid of interest. His spare time and money may tend to drift him into the ranks of the immoral and the wastrel. But to me the saddest fact of all is that his rate of wages reaches the maximum early, and when he has reached about the age of eighteen or early manhood he finds his prospect such as to sour his spirit and overcast with gloom his whole life's outlook. He finds that his wage, which was big for a youth of sixteen, will do no more for a man than keep him in the bare necessities of a poor existence. At the same time the mechanical, drudging nature of his occupation is gradually wearing the canker of monotony and disgust into his heart. Bring anyone to a state of things so embarrassing, to a prospect so cheerless, nay, so ominous of circumstances worse than have been yet experienced by him, and the degradation of that one is practically assured. Society, or should

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[1] Note from Reports by Chief Constables of Glasgow and Liverpool.

I say adverse circumstances, have set him aside out of the ranks of respectability, and are surely squeezing out of him all self-respect aye and all hope.

I have already referred to the fear that the effect of my recommendation might make trades in our labour world still more crowded, and have shown that this might be remedied by a more easy method of emigration to our colonies; but against this it might be argued that we had no right to spend our nation's money in the education of workmen for other countries. But do not let us lose sight of the probable gain even in money alone. Are we not wasting more in watching and punishing the immoral and the vicious? At the present time the conduct of the corner-boy and the hooligan strikes terror into every heart, while the hopeless waifs and strays call forth our deepest sympathy. Our object should be to save the boy from falling into courses which work out his ruin and make him, in too many instances, a nuisance—a most expensive nuisance—and danger to the community.

Since reading this paper Mr J. G. Legge, Director of Education, Liverpool, has kindly sent to me the report of the Police Establishment on the state of crime in that city for the year 1906. It shows that of 944 juvenile offenders, including 860 boys and 84 girls, the larger proportion were young people between fourteen and sixteen years of age. The figures are:—

Under 10 years of age,	153
Between 10 and 12 years of age,	218
Between 12 and 14 years of age,	282
Between 14 and 16 years of age,	291

Mr J. V. Stevenson, the Chief Constable of Glasgow, also furnished me with interesting statistics showing the number of youths between fourteen and twenty-one, charged with theft and other offences in the Glasgow Police and Sheriff Courts during the same year. From this statement also it appears that out of a total of 1,454 dealt with, no fewer than 332 were between the ages of fourteen and sixteen.

Now I will revert to the other aspect of the problem upon which I touched—namely, the lack of proper control of lads who are already apprenticed to trades. I have chosen from my district in Glasgow the following six trades,—engineering, boilermaking, iron and steel founding, printing, lithographing, and bookbinding. My information regarding the career of apprentices in these trades is more reliable than in any others. Of these, engineering appears to be the most popular, and it is an interesting fact that of engineering apprentices in this district, 8$^{\circ}/_{\circ}$ were drawn from the families of professional gentlemen, 8$^{\circ}/_{\circ}$ from the families of engineers, and 30$^{\circ}/_{\circ}$ from other well-to-do tradesmen's families, while the remainder, which is the largest percentage, was drawn from the families of casual workmen, thus showing that in the selection of the apprentices no partiality for any particular class is indulged on the part of employers, the chief recommendation being apparently the personal character and educational attainments of the boy. The principal point to which I desire here to draw attention is that, of these apprentices, not more than from 50$^{\circ}/_{\circ}$ to 55$^{\circ}/_{\circ}$ completed their time and obtained first or second class lines. What of the others? I have it on the most reliable statistics that 15$^{\circ}/_{\circ}$ deserted the trade voluntarily before the completion of their time, 2½$^{\circ}/_{\circ}$ left to join other trades, death or ill-health accounts for 7$^{\circ}/_{\circ}$, while no fewer than 15$^{\circ}/_{\circ}$ were discharged for insubordination, including bad time-keeping. In some works the percentage of those discharged comes near to 25$^{\circ}/_{\circ}$. This proportion of careless and wayward apprentices furnishes us with our chief concern. With regard to the behaviour of the other proportion it is interesting and gratifying to learn that in almost every establishment about 50$^{\circ}/_{\circ}$—which is exactly the proportion of those who completed their time—attended evening classes during the session.

In the boiler-making department the results are not even so satisfactory. Taking all the establishments, the percentage works out at 40$^{\circ}/_{\circ}$ who completed their time, 35$^{\circ}/_{\circ}$ left, 3$^{\circ}/_{\circ}$ on account of ill-health, and 22$^{\circ}/_{\circ}$ were discharged.

In the iron and steel founding industries the conditions are far from satisfactory. There are two well-defined classes of work, one in which the operatives are paid by time, and the other in which they are paid according to piece-work. In the former the men are generally steady and regular in their habits, and their records of long service would compare very favourably with the records in any other trade; and as to apprentices, not fewer than 90 per cent. completed their time. Only 3 per cent. attended evening classes, but there was also this suggestive fact elicited, that 3 per cent. became managers or foremen in their own or some other establishment. In piece-work shops the results were very different, and I could find no evidence whatever of any of the apprentices attending evening schools. In one shop of this description fourteen apprentices are employed, and the master, to show his interest in their welfare, paid all their expenses for the full term of last winter's continuation classes, but with this disappointing result, that twelve attended for a week, and only two for a full month; and this, I think, gives illustration to my contention that these boys, having from their fourteenth till their sixteenth year, at least, had uncontrolled freedom, find it very difficult to settle down again to study, even if they are moved by a temporary desire to learn; and it is only logical to think that they, therefore, stand in need of the firm direction of the State as well as the friendly influence of employers and social agencies to steady their characters, give decision to their actions, and save them from loose habits and perhaps wicked conduct. In all piecework shops the operatives are generally unsettled, irregular, and migratory in their habits: consequently discipline and organisation are difficult to maintain. At all hours during the afternoon men will be seen leaving the foundry, and while this may be due in some measure to the conditions of casting, it is a well-known fact that many leave and go home because they think they have done sufficient for the day. This idleness and irregularity are almost entirely the outcome of intemperance. A squad of seven men were employed in the execution of a certain well-paid order, and on the day of my visit the foreman was much worried and excited because none of the men had put in an appearance since being paid ten days previously, not having yet, apparently, completed their senseless carousal. Alcohol has a wonderful fascination for these men. Nor can the grimy nature of the occupation be entirely to blame for this, because one day I was admiring some engineers earnestly at work fitting up an engine for a new vessel. It seemed to me that no sculptor could have given more care and anxious application of mind and hand to his work. I remarked to the foreman—"I am sure these men are all total abstainers, or they could never execute such beautiful work."

"Deed no, sir," he replied, "I don't think there is one of them who has not had his mornin' tae steady his hand."

Bearing on this question, I read an article in the *Worlds' Work* for October, 1906, which I consider of great interest. The writer, an American, contrasts the habits of our workmen with the habits of the workman in America. He says:—"The American uses more milk than the Britisher. He spends more money on luxuries and legitimate pleasures, and the food he eats is more varied and of better quality. It is the intemperance, coupled with a love of gambling, which seems to be born in many workmen, that eats into their very life and frequently keeps them in abject poverty. Many American labourers openly drink bottles of milk, and do not seem ashamed to be seen doing so. The British workman differs from the American in seemingly small matters, but which are in reality very important ones. One of these refers to the different ideas about drink which prevail. During my apprenticeship in England it was my practice to take with me a large bottle of milk, which I had to hold under the table while pouring it into my tea to avoid being the victim of endless and unmerciful chaff for my babyishness, the others favouring the more manly (?) liquid, beer, upon which fluid a considerable percentage of their earnings was spent. Many of the men had a deep-rooted conviction that they could not get through a day's work without the assistance of some such alcoholic stimulant."

Now, this contrast of British and American workmen may be viewed by some as partial in its compliment to the more sensible habits of the American. As to that, I am not in a position to give an opinion; but in its description of the habits of workmen on this side of the Atlantic it is, so far as my experience has enabled me to form an opinion, perfectly true. It is well known and generally agreed that the British workman as a rule indulges in the use—or should I say abuse?—of alcohol to an extent which seriously affects his own health and social well-being, and handicaps our country in competition in trade with our rivals. We needed no such manifesto in defence of the use of alcohol as was published the other day in *The Lancet.* That alcohol has helpful properties for the treatment of disease and certain conditions of physical exhaustion probably few doctors will deny. I have prescribed alcohol, and I have no doubt will have reason to prescribe it again. At the same time, it has been impressed on my mind—and I am sure this fact has been observed and fully appreciated by every one of the eminent medical gentlemen who signed that manifesto—that the more temperate the patient has been in his ordinary habits the greater the benefits to be derived when alcohol requires to be taken as a medicine. Indeed, I might go so far as to say that the more it is used even as an article of diet the less restorative and curative are its effects upon the system. The truth is, this manifesto has said all that can be said for the use of alcohol as a drug, and as such it would be well for the public to carefully consider the terms of moderation with which it is commended. Lately a Departmental Committee was appointed by the Home Secretary to inquire into certain diseases of occupation which might be scheduled in the new Workmen's Compensation Bill, and I was asked to give evidence. The list of diseases presented to me included that of neurosis, due to vibration from the use of pneumatic tools. I had never heard of it, but I examined the men in every work in my district in which these tools were used, and found only one alleged case. The patient stated that he had suffered from "nervousness," and that his medical adviser had ordered him to change his employment. He did so, but had again returned to it. The man was markedly neurotic in temperament, and the "shakers" were quite evident in his hands and forearms. He confessed to an indulgence in alcohol, and, being anxious to know to what extent, I warily inquired if he did not imbibe more freely on Saturday than on other days. His frank and laconic reply was suggestive—"No, I mak' nae exceptions." Again, in cases of lead and mercurial poisoning I have invariably found that, contrary to their own ideas, men who drink are rendered more liable than those who are temperate; in fact, I cannot recall a single case of industrial poisoning in a total abstainer, though many of them have been exposed in the same industry for over thirty years.

Now, this may seem to you an unnecessary digression, but I am inclined to think you will agree with me that its important, if somewhat indirect, bearing on the subject before us gives some justification for that digression, and makes it pardonable.

I have referred to the general conduct and life of the men employed in piece-work shops, and I do not think you will be surprised to learn that their example and the circumstances connected with their occupation have an immoral effect on the character of the apprentices. Not one of these apprentices attends evening classes. Their rate of wages begins at five shillings per week and may rise to twenty-four shillings. In one work with about thirty-five apprentices I had the privilege of looking over the time and pay-sheets, when I made the astonishing discovery that, for the one quarter last year, twenty-six lads lost 2·7 days per week, which to an apprentice with the maximum wage, represented a monetary loss of about ten shillings a week.

About one-third were steady, sober and reliable, and their average weekly wage was over one pound, while the wages of the others seemed to be regulated by the demands of necessity, and were in some instances as low as seven shillings and sixpence, and even four shillings and elevenpence per week.

I have yet to speak of the other three trades, printing, lithographing, and book-binding. The number of apprentices who attend the Technical College in these trades varies according to the character of the work done in the shops. In one large establishment not one of the apprentices attended the College, and the reason given was that they objected to work all day and then go to school and begin again in the evening. In another establishment where the work is more varied six out of twenty, or 30 per cent., attended classes. In these three trades I made much the same discovery, that, if the work being done were artistic or high class, or, again, if it were chiefly jobbing, very few attended the College, the reason, so far as I could learn, being that they could learn their trade as well in their own shops. To my mind this excuse is false and misleading, because it is not at all consistent with the complaint, which is perfectly well founded, that pressure of work and the need to better economise time has brought about a system of division of labour in these workshops which has the effect of confining a workman, and even the apprentices, for almost all of their time to one particular branch of their trade; and it seems quite fair to argue that the apprentice who in these circumstances declines to take advantage of classes where he may get some knowledge in any or all of the other branches of his trade is clearly not much concerned as to whether he become a good all-round tradesman and thus increase his value, or remain a workman with very limited capabilities even in his own sphere of industry.

The skilled workman is as important to the nation as the educated man, and if the standard of excellence in mechanics in this country is to be maintained, the young men who expect to follow a trade must have their minds developed and their hands trained. The work in the Technical College, so far from being uninteresting or monotous, or even approximating to what may be found in an artistic or general shop, enables him to undertake work in the earlier days of his apprenticeship with which no employer would entrust him until after several years' service. One can readily understand how beneficial this would be, in the first place, to the apprentice himself in increasing his wage-earning capacity, and, secondly, to his employer, not only in the increase in the worth of the work, but in the decrease from loss of time and material. In these days the division of labour and piece-work, especially in our large establishments, have given occasion to a well-founded complaint that our youth have not the facilities for learning their trades. To remedy this, and to largely increase the number of skilled mechanics—which is absolutely necessary, nay, urgent—at the present day in this country, attendance at the Technical College must be compulsory.

Once more I advance the contention that there is need for interference on the part of the State. The facts I have been able to submit to you give rise in my mind to a great variety of thoughts, but none are more insistent than these: (1) that apprentices as a rule apply themselves in a distinctly perfunctory way and with indifferent mind to the learning of their trade, and therefore are in need of some controlling authority which shall insist on greater sincerity and earnestness of application; and (2) that the example shown by their elders in the trade is often distinctly bad, and requires to be counteracted by a more intimate relationship between the employer and his younger workers, assisted by a more intimate influence on the part of the Church and other moral agencies. Every thinking person in these days recognises the importance to our country not only of our workmen being highly skilled, but constantly increasing in efficiency, and so keeping us ahead of our rivals; but nothing has so far been done to ensure this, except in a purely voluntary way, as illustrated in our technical colleges and evening schools. No doubt purely voluntary effort is most to be desired, but in the great mass of our youth all attempts to inspire it have failed, and it is time to apply the necessary degree of force. After all, this application of force on the part of the State would in almost every case, I am convinced, be merely helping the boy to the attainment of his own desires by adding strength to the weak side of his character. He may have a desire to learn and be expert at the thing he has set his mind upon, and if he do not make an effort to gratify that desire, it is chiefly because he lacks the force of character necessary to carry him in the way he would like to go. Let the State assist him where he is weak. In these days of general division of labour in our workshops, the whole country is likely to suffer more and more from want of skilled workmen with all-round ability in their business; and, unless there be a very large accession to the numbers who attend our Technical Schools, the conditions will become worse than at present. To my mind the only way to attain this would be through an Educative Authority supervising and directing the training of every youth until his seventeenth year, making attendance at school for two nights in the week compulsory.

Regarding the influence which ought to be exercised by employers and moral institutions, I will say just a little, and then I have done. It is unfortunate, I think, that the tendency is apparently for workmen and masters to go wider and wider apart. Perhaps the works are growing too large and the workmen too numerous for the employer to make any pretensions to being closely acquainted with his workmen. Perhaps it is that the employer is too much engaged in a life made up largely of a superior kind of dissipation to find time to think much about the more vulgar kind of debauchery in which his employees may indulge. I say so because I believe that in some instances it would be a perfectly just description of the cause. At the same time, there are employers who take an almost paternal interest in their workers, often, alas, with little encouragement or signs of gratitude. I instanced one case of that kind. I shall now give another which seems to me exemplary in an especial degree. I give it to the members of this society knowing that it will touch their hearts while it sustains their interest, for his loving memory as well as his striking personality are still cherished. I refer to the late Mr James Rowan, of Messrs David Rowan & Company. It was a surprise to me, as no doubt it will be to you, to learn that for many years he kept a record of the behaviour and progress of every apprentice, not only while in his service, but when, in pursuance of his calling, he had gone further afield. Before his death our respected friend gave instructions that all the statistics relating to his works should be put at my disposal, every assistance afforded me in the compilation of this paper, and especially requested that he be reminded of this meeting.

Such interest as he showed could not fail to have a good effect on the young men concerned. The example of the principal in a business would naturally be followed by his assistants in the management, and the influence generally would do more, perhaps, to improve the character and ability of workmen than could be easily estimated.

As to the work which lies before the Church, I need say very little. That institution is beginning to see its duties in a social sense and is tending to bestir itself. There is manifestly need for closer union and better organisation amongst the various agencies whose aims are the same. No one can justly complain of lack of moral and philanthropic agencies. As a matter of fact, their manifold operations bring more strikingly into evidence the utter want of proper union and organisation. When one contemplates the strength of the Church, and the agencies of a similar kind which have sprung up around the Church, one wonders how it should be possible to find a single moral wreck in our community. During the last three years over 20,000 juvenile offenders were convicted in the Courts of Scotland, and I have no doubt that if each case were investigated it would be found that the boy had gone astray because of a weakness in the influence of his home—perhaps through positively bad influence in his home. Again, I found in my inquiries that of thirteen apprentices who were discharged for bad conduct in a certain workshop, no fewer than nine had neither father nor mother, or were the sons of drunken and dissolute parents. Should such as these—children and youths with positively bad parents or no parents at all—not be the first concern of our Churches and like institutions? We might even have less preaching in the pulpit with more good work emanating from their halls, and more of real personal contact in the daily life, even in the field of sport, which, by the way, need not necessarily be a bad place. Let the boy and youth understand that his whole conduct is being watched with kindly interest and he will walk more circumspectly and thoughtfully. While we agitate for State control it would be well for each of us to remember that the State is not a thing apart from ourselves, but that we are each a unit of the State, and that there is such a thing as control by moral suasion and personal influence, which is even more powerful than the control which is exercised by the law. As a recent writer expresses it—"The only way of really helping a man is to strengthen him by education, timely assistance, opportunities—what you will—to meet his own difficulties and organise his own life." As a nation, we are always proud and rejoice at the *entente cordiale* existing between us and our foreign neighbours. I submit that it is vastly more important that *entente cordiale* and *esprit de corps* should exist to a greater extent than it does now between master and workman, between Church and people, in our own beloved land.

Iron bacteria and their connection with Stone-decay. By DAVID ELLIS, D.Sc., Ph.D., F.R.S.E., Lecturer in Botany and Bacteriology, Technical College, Glasgow.

[Read before the Society, 30th April, 1907.]

INTRODUCTION.

BY Iron-bacteria is meant those organisms belonging, so far as yet investigated, to the Thread-bacteria, which thrive in waters rich in iron, and which become coated with a deposit of ferric hydroxide derived from the surrounding water. In Lanarkshire and Renfrewshire, where a large proportion of the underlying beds is composed of ironstone, many small rivulets, and sometimes fairly large streams are coloured a deep reddish-brown, owing to the bubbling up of water, which has passed through this ironstone, bearing with it a quantity of iron in solution. This is found in the form of the soluble bicarbonate $FeH_2(CO_3)_2$. I have collected and examined this water, and when samples were taken immediately after the water had oozed out of the earth, the iron was found to be in the *ferrous* and not in the *ferric* condition. Hence, one point is clear, viz., that the oxidation into the ferric condition takes place after the iron has come to the surface, and the question arises as to the mode of formation of the ferric hydroxide. Now the whole of this compound is found deposited on the membranes of the iron-bacteria, and this fact caused Winogradsky in 1888 to assert that the oxidation was effected by the iron-bacteria. I propose in this paper to describe the various kinds of iron-bacteria, with special reference to the forms found in the neighbourhood of Glasgow, after which I shall discuss their physiological significance.

Crenothrix polyspora (Cohn).

This was first described in 1870 by Cohn, when attention was directed to it, on account of the drinking wells in the neighbourhood of Breslau being choked by the accumulation of ferric hydroxide. In 1878, the course of the water supplied to Berlin was seriously interfered with, and in 1888 the same happened to the Rotterdam water. Since then it has been found in France, Germany, Russia, England, and other countries. The organism consists of threads of cells, the latter being arranged in a single row. The threads are not uniformly thick, the basal part being narrower than the apical portion, but the cells in the basal part are longer than those at the apex. Each cell forms its own membrane, and in addition contributes its share to the sheath membrane, which envelopes the whole row of calls. The threads are attached to algæ, blades of grass, or any other convenient object that happens to lie at the bottom of the water. The diameter of the thread varies from $1{\cdot}5\mu$ to 5μ at the base, and from 4μ to 9μ at the top.

In addition to the multiplication by division, a higher method is found, viz., by the breaking up of the cells into a number of cocci which vary in size, the larger being known as *macrococci* and the smaller as *micrococci.* This process usually takes place in the upper cells. The cocci are exuded from the apical part of the thread, and settling down soon develop into new threads. Sometimes, however, all the cells of a thread break up into cocci, so that the whole thread is made up of them. Fig. 1 illustrates all the points mentioned above.

Cladothrix dichotoma (Cohn).

This organism was discovered by Cohn in 1875. It has the same habitat as Crenothrix polyspora, and in 1888, in conjunction with this organism, caused great trouble in the Rotterdam Waterworks. The organism consists of a tree-like branched tuft of threads, each thread consisting, like Crenothrix polyspora, of a single row of cells, held together in a delicate tube or sheath, though this latter is much more delicate than the same in Crenothrix. The branching is only apparent. Single cells slip out of the row and dividing to form a new thread, give this appearance (Fig. 2). In addition to the usual multiplication by division, there is also another method, as illustrated in Fig. 3. Single cells separate off from the others in the same sheath, round themselves off, and developing cilia are able to remove to some distance from the parent threads. They ultimately settle down and form new threads. Fig. 2 and Fig. 3 indicate the above mentioned points.

I have not been able to obtain either Crenothrix or Cladothrix in any of the iron waters in the neighbourhood of Glasgow, though it is possible that further search may reveal their presence.

Leptothrix ochracea (Kützing).

Syn. Chlamydothrix ochracea (Migula).

This form is found everywhere in this neighbourhood, sometimes in conjunction with Gallionella ferruginea, when it forms the predominant organism, usually in the proportion of twenty to one. Each individual consists of a long thread, not broken into separate cells, and possesses a fairly thick membrane, which is sharply contoured both on the inside and on the outside. The threads are not attached, but large numbers interweave so as to form a kind of rough network, though each individual is free at both ends, and quite stiff and straight. The community, as a whole, is often attached to the bed of the stream, though usually the threads lie in an irregular mass on the bed of the stream. The threads are uniformly thick, and the ends are rounded off similar to the bacillus cell. The average width is 2μ to $2{\cdot}5\mu$, though owing to the deposit of conidia it may attain to 5μ to 6μ. The thickness of the wall also varies, being very delicate in the young threads, but in the older threads it is coated with iron and reaches some thickness (Fig. 4). Multiplication by conidia has been known for some time. I have traced the development of the conidium. A protuberance is formed; when this reaches a certain size, it becomes constricted at the base, and is cut off. Soon a fresh conidium appears in its place, and as, when in full swing, every square millimetre is engaged in this process, the thread becomes covered with thousands of them, until its diameter is increased, sometimes to three times its original size. The conidia germinate in the immediate vicinity of the parent thread. In some cases the protuberance does not become constricted and consequently elongates, until a fair length has been attained. Ultimately these elongations become cut off and form new threads. When a thread shows these elongated threads, it has the appearance of being studded with quills all over its surface.

I have ascertained that, in addition, multiplication by cell division takes place in Leptothrix ochracea. At irregular intervals a thread may break up into separate parts, each part becoming ultimately separated and gradually developing into a separate individual. By clearing away the iron deposit by means of hydrochloric acid, the stages in the development of the cell-division can be observed. It is preceded by the formation of two small knobs on the membrane lying close together, and on the opposite side also the same phenomenon is observed (Fig. 5). The line of division takes place between the knobs. It is curious that the two knobs on one side of the membrane are not exactly opposite the knobs on the other side, and consequently the result is that the thread-portion cut off in this way has slightly oblique ends. Whilst the partition is taking place, two thin walls are formed across the membrane connecting opposite knobs. The two portions then gradually draw apart.

Gallionella ferruginea (Ehrenberg).

Syn. Chlamydothrix ferruginea (Migula).

This organism has been known since 1836, but has only recently been accurately studied. It is very common in this neighbourhood in the iron springs, but not usually very plentiful. Although usually associated with Leptothrix ochracea, I have once seen a spring composed entirely of this species. It consists of long fine threads, each thread winding round itself in a manner which can be represented by a hairpin being closely and spirally wound round itself (Fig. 6). The species shows a very great variation in size, whilst the average diameter of the thread is 1μ, it may be as small as $\frac{1}{4}\mu$, and as large as 1·5μ. The length also shows much variation. The number of loops formed by the twisting of the threads may vary from one to a large number. In one case I saw thirty-five loops, but the number may be more in exceptional cases. According to Migula, a very delicate external membrane is present, but I have failed to find it, even in the largest varieties.

Multiplication is usually effected by the cutting off of small portions of the threads. These detachments then proceed to grow and coil themselves in the same fashion. In my investigations on this species I was able to ascertain that multiplication by the formation of conidia also takes place. The coils usually loosen themselves so as to make the loop-space somewhat larger, after which conidia begin to be formed in the same way as described for Leptothrix.

Clonothrix fusca (Schorler).

In 1904, another genus of this group was found in the waterworks in and about Dresden. This combines the characters of Crenothrix and Cladothrix, in that while it has the general appearance of Crenothrix polyspora, it also possesses false branches similar to Cladothrix dichotoma. The threads appear to be dichotomously or irregularly branched, and attached at one end, thus presenting a differentiation of base from apex as the threads get thinner towards the free ends. The base measures 5·7μ in thickness, whilst the free end may be anything up to 2μ. The cells in the thread are 6μ to 8μ long, but sometimes 12μ to 16μ and even 20μ.

Multiplication takes place by the formation of small motionless *spores*, produced by division of the cells as in Crenothrix polyspora, though here there does not appear to be any difference in the size of the spores.

Spirophyllum ferrugineum (Ellis).

I have been fortunate enough to discover another member of this class, which was first found in great abundance in the iron waters near Renfrew, but I have since found that it is fairly common in the West of Scotland, and probably has a still wider distribution. The body of the cell is elongated, flattened, and spirally twisted. A typical example is shown in Fig. 7. The spiral turns may vary from a quarter to fifteen or more turns. The width varies from 1μ to 6μ. The length may reach to 200μ and possibly more. There is no definite cell membrane, but protection is afforded by the formation of a rampart all round the edge. This is probably a great help in protecting the cell from tearing when it twists itself spirally, and as twisting continues after a deposit has begun to be formed, this protection is probably all the more necessary. The ends are usually angular, irregular, and unsymmetrical. The spirals may be close or very wide apart, but the majority of the individuals have spiral lengths three to four times greater than the width of the organism.

Multiplication is effected by the budding off of conidia, the process being exactly the same as in Leptothrix ochracea. Large numbers of conidia are given off until the outline of the cell is lost, and the diameter is often more than doubled, because the conidia remain attached to the parent organism. Each conidium has a single coat, is oval in structure, and measures about 1μ in width and 1·75μ in length. Each germinates by bursting open the spore membrane, the contents being then protruded, after which the young vegetative cell is freed from the spore membrane. Soon after germination the young cell exhibits a faint movement, partly of a wriggly and partly of a pendulum nature. As soon, however, as the rampart is formed along the edge, and iron deposited on its surface, movement stops. Both the twisting and the conidia-formation begin very early, and the latter may continue during the whole of the life of the organism, in spite of the presence of a thick deposit of iron. This results in the formation of an enormous mass of conidia.

It is possible that multiplication by vegetative division also takes place, but I have only observed it in one doubtful case. After germination the organism at once assumes the flattened form found in the adult stage. Another interesting fact is that it is quite common to see two individuals twining round each other. This is probably due to contact irritability.

Claims to be called Iron-bacteria.

Whether these organisms merit the term Iron-bacteria in the same sense as we speak of Nitrate-bacteria, Sulphur-bacteria, etc., meaning thereby that they are concerned in effecting physiological changes, is not yet settled. It is generally assumed, however, that these bacteria do affect these changes, without, as I hope to explain, sufficient proof. In 1888, Winogradsky published his "Die Eisen-bakterien," in which he came to the following conclusions:—

1. The red-brown deposit on the membranes of these bacteria is due to the oxidation by the bacteria of the ferrous salt into the red ferric hydroxide.
2. This oxidation is intimately connected with the metabolism of the cell.
3. For the growth of these bacteria, ferrous salts are absolutely necessary.
4. By the oxidation of the ferrous into the ferric condition these bacteria obtain the energy necessary for their existence, *i.e.*, this is their method of respiration.

I have carefully read this paper, and find no proof of these statements. Molisch, in commenting on this paper, mentions that they were published as a kind of preliminary communication of his work on this subject. Since this time nineteen years have elapsed, but no further communications on this subject have, to my knowledge, appeared from the pen of Winogradsky. Other investigators have taken up this question, and the following new facts throw a different light on the matter.

1. It has been established that when grown in pure cultures, these organisms thrive splendidly without the addition of the iron compound, and, in fact, it does not make any difference whether

the iron compound be added or not, they grow equally well. If, when growing in a solution not containing iron, this substance be now added, then they begin to store it, just as they do in Nature. This surely points to the conclusion that the iron is not vitally necessary to the plant.

2. It has been shown by Klebs that Zygnema and other Algæ have a remarkable power of attraction for Aluminium, Chromium and Iron compounds. It may be added that the power of protoplasm to attract various substances, both organic and inorganic, is universal, and among bacteria is very marked: thus the salts of potassium are well known to have an attraction for bacteria, and they may be lured to their destruction by corrosive sublimate. We thus seem to have in the Iron-bacteria a case of chemotaxis, with this difference from the ordinary cases, that the Iron-bacteria, like Zygnema, are the attracting and not the attracted agents.

3. A third point is that iron can be replaced by manganese, for which also the organism has a remarkable attraction. It has rightly been pointed out that nowhere in Nature is iron necessary to a plant, and at the same time replacable by manganese.

These facts point to the conclusion that iron is not necessary for the metabolism of the plant, and if of any use at all, that use is not connected with the metabolic mechanism. It must, however, be added that Adler has recently shown that the addition of antiseptics prolongs the precipitation of ferric hydroxide, *i e.*, it would seem that the change into the red ferric hydroxide is expedited by the fact of the organism being present. This research needs confirmation as it goes against the trend of the work of the past twenty years. But even if true, the organism may hasten the precipitation in a purely mechanical manner. One possible explanation is that these organisms may assimilate and thus give out oxygen, which would, of course, hasten the process. In my own experiments I have found that the presence of sunlight does not act as a deterrent to the growth of these forms, and it is just possible that they possess a certain amount of colouring matter performing the same function as chlorophyll. Again, I may add that it is very remarkable that in Winogradsky's prescription for the cultivation of Iron-bacteria, *ferric* hydroxide is given as one of the ingredients. If these organisms obtain their energy by oxidising the ferrous into the ferric condition, it is strange that the oxidised product should be presented to them as food material. It seems to me that the strongest reason of all, why the metabolic standpoint cannot be maintained lies in the fact that it is so easy to oxidise the ferrous carbonate into ferric hydroxide by simply exposing it to the atmosphere. The soluble bicarbonate is oxidised according to the equation:

$$\left.\begin{matrix}2\ \mathrm{Fe\,CO_3}\\ \mathrm{H_2\,CO_3}\end{matrix}\right\} + \mathrm{O} + 3\ \mathrm{H_2O} = \begin{matrix}\mathrm{Fe_2(OH)_6} + 2\ \mathrm{CO_2}\\ \mathrm{H_2O} + \mathrm{CO_2}\end{matrix}$$

It is well-known to chemists that it is impossible to retain ferrous carbonate as such when in solution, because after even a few minutes the effect of oxidation by the atmosphere is noticeable, and it is extremely unlikely that an organism would compete against the atmosphere, seeing that the oxidation effects of the latter are so rapid. I do not think the organism would stand much of a chance if its existence depended on its being able to prevent the atmosphere oxidising the ferrous carbonate, in order that it might substitute its own oxidising powers.

Connection of the Iron-bacteria with Stone Decay.

I began this investigation primarily with the idea that I should be able to effect some interesting bacteriological work on a subject which, in Glasgow above all other places, cries aloud for attention. Bacteria have often been found in places where decay is in active progress, and as ferrous carbonate is a constituent of sandstone, it was worth while investigating the possible connection of Iron-bacteria with the decay. That the Iron-bacteria are connected with this decay has been on several occasions asserted, but I can find no trace of any publications in which an account is given of serious scientific work on this point. So far as the Iron-bacteria at present known are concerned, I can state that they are never found on stone whether the latter be in a state of decay or in a perfect condition. I have thoroughly examined all the Iron-bacteria in this neighbourhood, and have seen them in all the phases of their life-history, and am consequently quite convinced on this point. The Iron-bacteria are so peculiar in their appearance that their identification is a very simple matter. Again, even if found on stone, we should still have to prove that they occasion the change from the ferrous carbonate into the ferric hydroxide condition, because, as explained above, this can be effected very rapidly by the atmosphere if the carbonate be in a moist condition. I have also explained above the reasons for the conclusion that the Iron-bacteria do not effect this change, but that this is done by the atmosphere, and that after the ferric hydroxide has been formed, the Iron-bacteria attract this substance and deposit it on their membranes. It may also be pointed out that it is extremely improbable that organisms with the peculiar life-history, and possessing the peculiar forms of the Iron-bacteria, could thrive on the surface of stone. I think we may safely dismiss the Iron-bacteria so far as their action in producing stone decay is concerned.

Possible connection of other bacteria with Stone-Decay.

There still remains the possibility that bacteria, other than the Iron-bacteria may cause changes, resulting in the disintegration of the stone. We are here confronted with two possible methods in which the stone may be attacked.

1. Bacteria may thrive upon the materials of which the stone is composed.
2. Bacteria may thrive upon matter that happens to be laid on the surface of the stone, and in the course of the life of the bacteria acting on this matter, secretion products formed by them may affect the stones injuriously, producing its disintegration.

I. With regard to the first possibility, we can best discuss this aspect of the case, by considering the various components of stone. The white sandstone of this neighbourhood is composed of Magnesium Carbonate, Calcium Carbonate, Ferrous Carbonate, Ferric Hydroxide, together with quartz grains, mica, and very small quantities of other matters, which need not be discussed. As we have shown that bacteria do not feed upon the iron compounds, they may be dismissed. So far as the Magnesium and Calcium Carbonates are concerned, no bacteria are known which thrive upon these substances. With regard to the quartz, mica, and other substances found in stone, not mentioned above, I do not think anyone will maintain that they form materials suitable for bacterial activity. As in the case of Ferrous Carbonate, the Magnesium and Calcium Carbonates are acted upon by the atmosphere, in this case the carbon dioxide constituent of it, and we thus have a purely mechanical explanation of stone-decay, which seems to me to be all-sufficient.

II. With regard to the second possibility, that bacteria may whilst on the surface of the stone thrive on other material, and in the course of their life, secrete acid products, the case is somewhat more difficult. There is one point which must be strongly emphasised, viz., that the presence of bacteria on stone does not prove that bacterial activity is taking place. Stones, like all other substances, not specially sterilized, contain bacteria on the surface. Hence, when decay is in progress, doubtless, a large number of bacteria will be found on the surface of the stone, especially as decay takes place in their moist parts, so that when bacteria happened to settle on the surface they would not be blown away again. If decay were due to the action of micro-organisms, certain forms would be found to predominate, but such is not the case, and microscopical examination does not reveal an appearance different to that of any other moist exposed surface. The very variety of the forms found on the stones shows that these are there in the resting condition, either as spores or possibly as resistant vegetative cells, casually blown there or deposited under the influence of gravity. There is another fact which has an important bearing on the question, viz., that I have seen cases of stone decay in spots where no micro-organisms were present. I purposely chose these places for examination, because, in each case, the decay-spot was protected from the atmosphere, taking place in a kind of upward pocket. The outside part of the wall was intact, but forming a mere skin over the decayed part. As bacteria are subject to gravity, they could not obtain access to this pocket, and there we had a case of lively disintegration, without any trace of micro-organisms.

The well known ease with which the atmosphere oxidises the Ferrous Carbonate into the hydroxide, points to one factor which is instrumental in causing this decay. As Ferrous Carbonate is a a constituent of stone, there is no doubt that when kept continually moist the stone will gradually be deprived of one constituent, which will tend to loosen the rest of the stone.

Personally, I believe that the mechanical processes taking place in stone are sufficient to explain the cause of decay. We have as factors—

1. The disintegrating effect of CO_2 in solution dissolving out the $CaCO_3$.
2. The disintegrating effect of water with, in places like Glasgow, a small amount of H_2SO_4 in solution which seems to enter as a factor, as the decayed stone has been shown to contain more than the normal amount of sulphates.
3. The oxidation of the ferrous carbonate to the hydroxide through the agency of the atmosphere.

When once the thin end of the wedge has been driven in, we have further aids in the changes of volume of the stone due to

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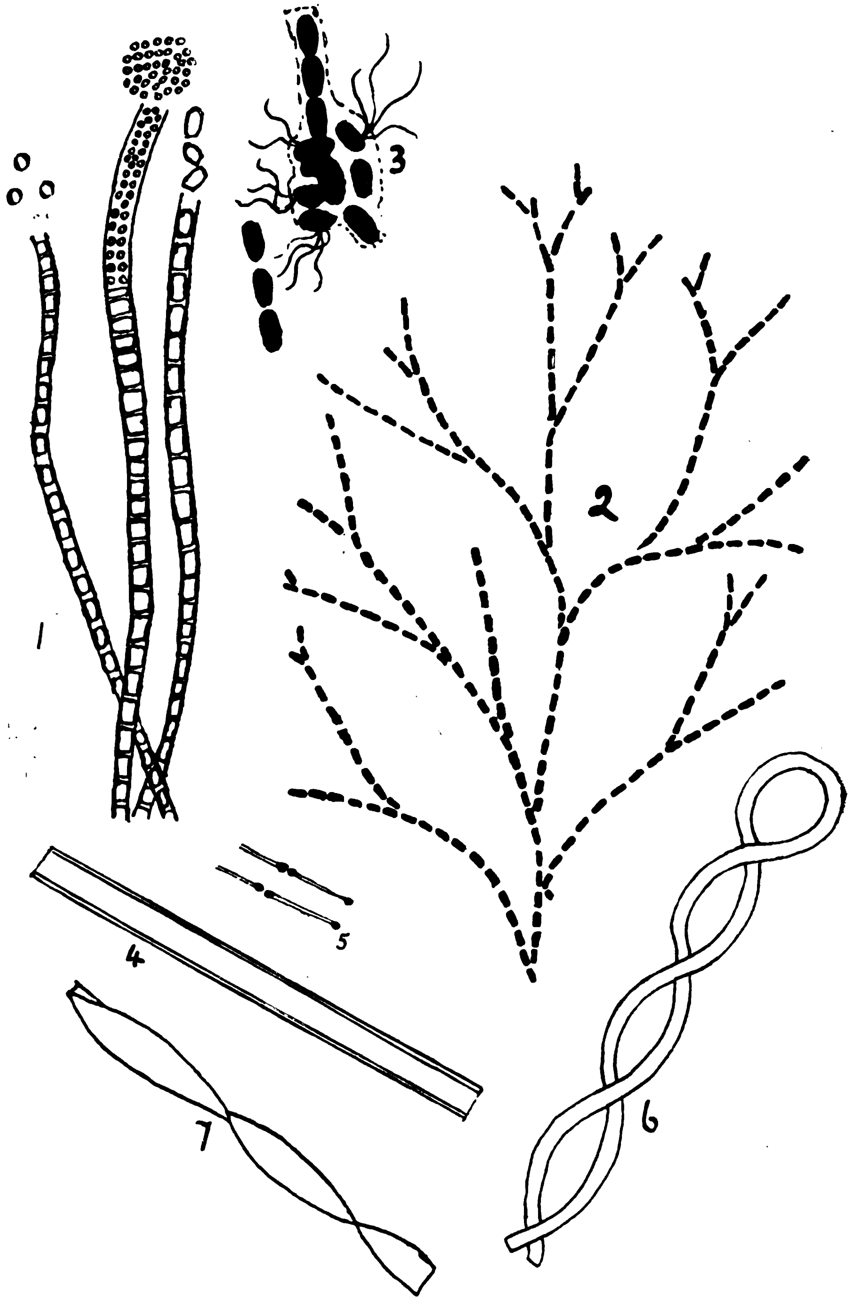

changes in temperature and the disastrous effect of the increase of volume of water when it changes into ice. All these require that the stone be moist and segregation of moisture on certain spots explains why decay takes place in certain parts only. It seems to me that the whole subject needs to be taken up by a combination of practical men and scientists, in order that the facts gained by experience should be collaborated with the opinions of science. At present it is only the *opinions* of experts that in one form or another, are presented to us, and what is required is experimental work to test the value of these opinions. If a commission were appointed, experimental tests could be instituted, as the results of the conclusions gained by this collaboration, and the exact bearing of the various factors claimed by various experts could be properly estimated. At present we are not in the discussion stage, and much money has been spent in buying preventives which in the present state of our knowledge effect cures, if cures take place, entirely by accident. This must especially, apply to antiseptic cures, for the action of micro-organisms in causing decay has not been proved, and to those who maintain that they play a rôle in this decay, I can only say that the onus of the proof lies with them.

Recent Work on X-Ray Measurement. By LORD BLYTHSWOOD, LL.D., and WALTER A. SCOBLE, A.R.C.Sc., B.Sc.

[Read before the Mathematical and Physical Section, 7th March, 1907.]

THE Rontgen rays are now used extensively for radiography and dosage, but very little is known regarding their various actions; pure physicists have taken small notice of the practical applications of the rays, and those engaged in the work are generally handicapped for accurate research.

A great number of problems present themselves in this connection, and their solution is often rendered difficult by the multiplicity of the varying conditions which affect a result. It has been necessary to clear the ground, removing erroneous notions—they are not worthy of a better name—so that a clear view could be obtained of the many questions involved.

The most pressing need is an accurate means of measuring either the intensity of the rays or the integral of the intensity for any given time. The methods at present adopted are either inaccurate or inconvenient; it is perhaps in consequence of this that many operators rely on their judgment rather than measurement, and faulty judgment sometimes causes the cases of burning, and even death, which have been reported.

The Rontgen Society is alive to the need and danger, but have probably delayed satisfying the need by appointing a Committee to try to obtain a Radio-active Standard, as the consideration of the general problem will mask the importance of practical measurement. We are trying to obtain information which will be of value not only during the consideration of a Radio-active Standard, which is hoped to become a reference for X-rays, but also for practical measurement, dosage and radiography.

When considering the main apparatus employed for the tests, it is necessary to note that for the most important part of the work we wished to measure many quantities to determine the relations between them. The coil was an 18 inch Apps. Newton, run off a 100 volt storage battery through a resistance and mercury jet interrupter. A condenser was connected across the primary coil, and one terminal was earthed for safety.

As we wished to measure the current in the secondary circuit, a point-plate gap and valve tube were included to suppress the back current. The milliammeters commonly supplied are useless, so we made an instrument on the lines of a D'Arsonval galvanometer, the special features being an insulating frame for the coil, which was covered with paraffin wax, a wide gap between coil and magnet, a heavy cylindrical weight rigidly attached to the moving coil, and in a later form liquid damping by vanes attached to the weight. A condenser was placed in parallel with the ammeter, one terminal being earthed. The special arrangements were necessary on account of the peculiar wave form of the current in the secondary circuit. An electrostatic voltmeter and a point-plate gap were connected across the focus-tube to give readings of the voltage across and equivalent spark gap of the tube. To measure the amount of ionisation caused by the passage of the rays, a gap between two circular brass plates was enclosed in a lead box with thin aluminium windows at the front and back. The gap was in series with a source of potential, the usual small storage cells, and a very delicate galvanometer; either 200, 400

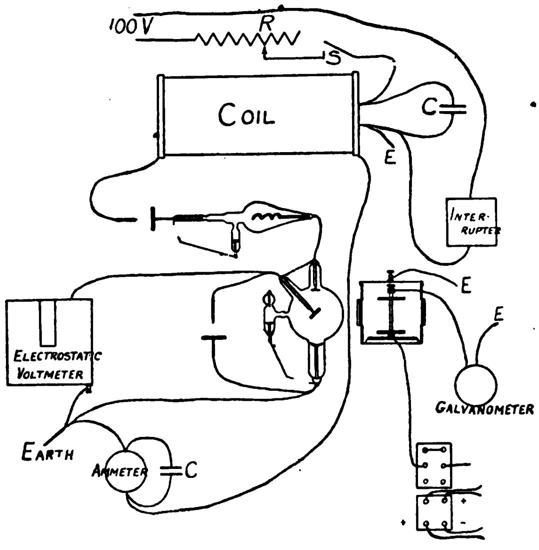

Fig. 1.

or 600 volts could be employed in this circuit. There were brass guides at the front and back of the box to hold a lead shutter, aluminium screens or photographic plates, and in certain cases there was also a holder for photo plates at the side of the box.

The tests to be described may be conveniently divided into four sections,—(1) On the relative speeds of photo plates to light and X-rays, (2) A test of Kienboeck's Quantimeter, (3) Tests to determine which of the measurements are proportional to the intensity of the Rontgen rays, (4) On the relations between ray intensity and exposure. We wished to commence with tests of Kienboeck's Quantimeter, but our large coil broke down, so the tests of the first section were made.

We obtained photographic plates from one maker to cover the range of speed as uniformly as possible, filling the gaps with other kinds selêcted from as few sources as possible. With one exception, the plates were not specially made for radiography, as we hope to make experiments with X-ray plates later. The speeds of most of the plates used are published, but any speed measurement, either for light or X-rays, must be more or less arbitrary. We measured the speeds for light by a method of our own. A white card was illuminated by a Nernst lamp, which emits rays almost uniformly distributed from the infra-red to far into the ultra-violet, and an image of the card was formed on the focussing screen of a camera. A dark slide was made to carry two plates, that under test and one of a standard make, and there were three slides so that three different exposures could be made on the same plate. The slide was placed in the camera, and exposures were made in the usual way, the Standard plate serving to check any variation of the intensity of the illumination, although this was very small, as the Nernst lamp was run from storage cells with no other load. This appeared to be a fairer test than exposure to candle light. The plates were developed with ferrous oxalate, always at 20°C, for exactly five minutes. The exposures required to give transparencies of the developed plates of 0·2, 0·5 and 0·8 were thus determined, and it was found that the mean proportions between these times were 11 : 3 : 1. The exposures being A, B and C, $\frac{A+3B+11C}{3}$ was taken to express the average time required to produce a definite image, or may be taken as the inverse of the speed of the plate. When considering the results, both the speed thus found and that given were used.

For the X-ray exposures the plates were contained in two paper envelopes held in a stand about 25 cms. from the anticathode. The focus tube was run quite steadily and varying exposures were made on Lumière Rontgen plates, and continued for larger doses on Ilford Process plates. These were developed, measured, and accurate curves obtained connecting the exposure and transparency of the developed plate. A piece of Standard plate was placed in the same envelope as that under test during the X-ray exposures, the Standard plate checking the quantity of rays which had acted. One exposure to the rays was adjusted to give a transparency between 0·5 and 0·6, another being made exactly six times as long as the first. The exposure which gave the transparency with the experimental plate was compared with that required to give the same transparency on a Lumière Rontgen plate. The mean of the two values was taken to express the ratio of the exposure required with the plate, to that which gave the same result on the Standard plate, or the inverse of the speed for X-rays. The general character of the results is shown in Fig. 2, in which the inverse of the speeds to light and X-rays, or numbers

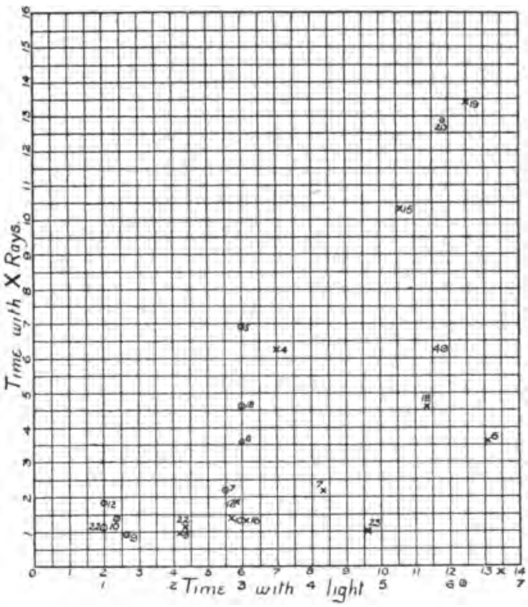

Fig. 2.

proportional to the exposures required to produce a given result, are plotted against each other. There is a very rough indication that the faster a plate to light, the faster it is to Rontgen rays; but taking different plates having the same speed with light, the speeds to the rays may be very different. The crosses represent the measured, and the circles the published times with light.

The photometer on which all our transparencies were measured consisted of two fixed Nernst lamps run from storage cells at 100 volts with no other load. On the central moving portion there was an Abney screen. The screen was made by cutting a square hole in a metal plate, one side of the metal being then covered by thin white paper. A rectangular hole was cut in a piece of thick black paper, one side of the rectangle being twice the other, and this was fastened so that the space included the square without, and another with, a metal backing. In use, one square was illuminated by transmitted, and the other by direct light, a metal plate screening the transmitted portion from direct illumination. The squares were viewed through a tube by reflexion in a mirror. A zero reading was taken; the plate to be measured was then clamped at the back of the hole and the intensities of the squares were again balanced. The average error in the value of the transparency was about 0·004.

The method adopted with the Kienboeck Quantimeter is to enclose a strip of photographic paper in a double envelope, which is placed on the skin during treatment. The strip is developed for one minute in a Standard solution, a clock striking minutes being supplied with the apparatus. After development the strip is compared with a scale consisting of seventeen different tints, each tint being marked with the dose to which it corresponds. Variations in the speeds of different batches of paper are corrected by altering the strength of the developer.

The advantages and disadvantages of the method may be given in the maker's words—"It has the advantage that it is more sensitive, gives more sub-divisions, leaves a permanent record, and is much cheaper than other Chromo-Radiometers. Its only disadvantage is that the results can only be read off after a strip of paper has been developed, a process which occupies three minutes (including fixing and washing)." Most of the chemical actions employed for this purpose are produced or reversed by light, so that comparison must be made with a poor illumination, but this method is free from that disadvantage.

A table will indicate the character of the results.

Set.	Relative Exposure.	Scale Readings.	
		A.	B.
1	1	¾ –	⅝ ¾ +
	2	2	1½. + . 2.
	3	2½ – . 3.	2 + . 2¾
	4	5 – 6 – .	4 – . 5.
	6	6	6 – . 7½.
	8	8 – . 8.	7½. 9.
2	1	¾ +	1 +
	2	2	2
	3	2¾.	3½.
3	4	—	3. 5
	5	—	4½. 7
	6	—	6 – . 9½

The intensity of the rays was constant, and exposures were made at 10 cms. from the anticathode. It was necessary to shake the developer in the small tube used, or the density did not increase so rapidly as the exposure; but when the developer was kept moving the strip gave different values at the top and bottom, hence the two readings, and for this table two observers, A and B, matched the tints. The method is by far the best of its kind in use, but the séance must be stopped for development and comparison of the strip, and errors due to the personal equation and comparison of tints are very large.

The object of the third series of tests was to discover if any one measurement would indicate the intensity of the X-rays. For our purpose measurements of the intensity should be based on the therapeutic action of the rays, but this reference could not be made; we therefore based our measurements on the principle of the instrument described above. A tractable focus tube was run quite steadily and Ilford Process plates were exposed to the rays for different times; the plates were developed and their transparency measured, all the work being carefully checked. The curves of Fig. 3 were drawn from the readings taken, and form a scale of quantity of X-rays. As the intensity of the rays was kept constant, the quantity was proportional to the exposure. Two exposures were made during each of the later tests, and from the transparency of the plate, by referring to the curves, the equivalent exposure could be obtained; if the exposure was the same in all cases this equivalent exposure was proportional to the intensity.

It is doubtful to what extent the photographic action of the rays is affected by their hardness, but as the rays were unscreened for the measurements plotted, errors due to this cause should be small.

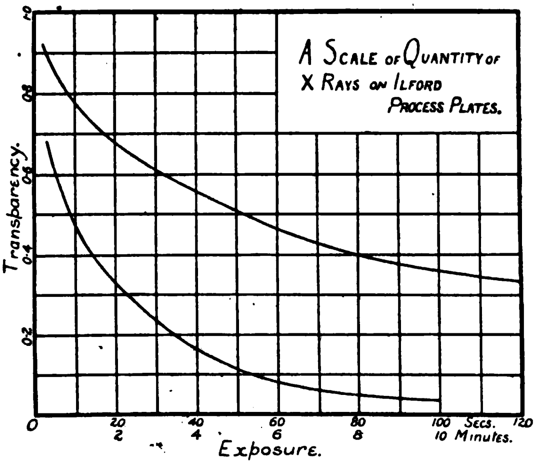

Fig. 3.

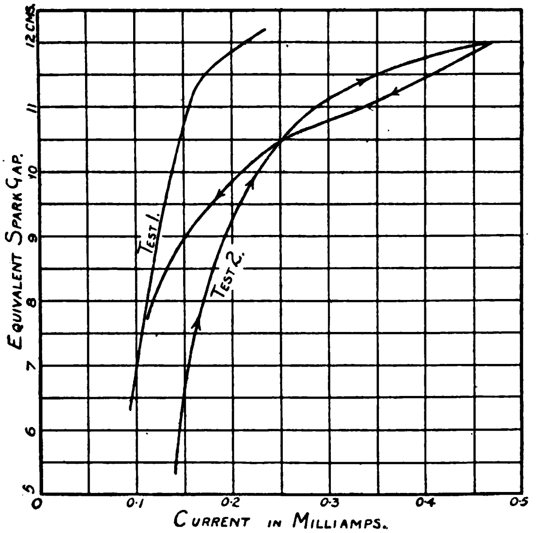

Fig. 4.

We first made tests to determine how far the equivalent spark-gap could be relied on to indicate the condition of the tube. Fig. 4 gives the relation between the equivalent spark-gap of and current through the same tube at different times. It will be noticed that the spark-gap varies enormously with the current; after a rest a tube may harden and have the same spark-gap with less current. The tube was gently warmed before test 2, which accounts for the lower part of the curve with decreasing current being higher than that with increasing current. Apparently a heavy current passing through the focus-tube generates so much heat that the vacuum is let down, therefore the curve with increasing current bends over, and the return portion is the lower for heavy discharges.

The main tests were made on a Cox Record Regulating tube and a Müller Water-Cooled tube. Only one set of results will be given.

After the photographic exposures had been made, aluminium screens of different thickness were placed in front of the window in the lead box, and readings of the leakage current were taken, thus analysing the rays.

The voltage varied less than we expected; with a harder tube even less than in the table given. Fig. 5 shows curves connecting the intensity of the rays with the current through the tube, tests 1 and 2 being on the Cox tube, and test 3 on the Müller Water-Cooled tube. The current required to produce rays of a given intensity depends enormously on the condition of the tube, a soft tube taking a greater current. When the points were off the curves it was known to be due to hardening of the focus-tube, or

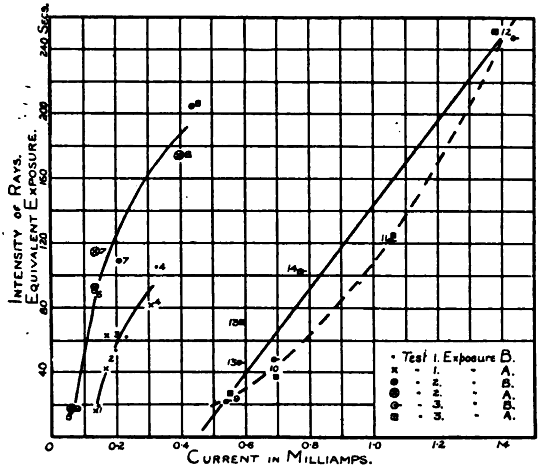

Fig. 5.

MULLER WATER-COOLED TUBE.

No. of Photo.	Current in Milliamps.	Voltmeter Reading.	Equivalent Spark-Gap cms.	Exposure Minutes.	Photo Transparency.	Equivalent Exposure Seconds.	Deflexion of Galvanometer Leakage Current.	Thickness of Al. Screen mms.
9 B	0·54	14200	Too small to measure.	1	0·672	21·6	1·05	0
9 A	0·55	—		2	0·479	55	1·05	0
							0·25	1
10 B	0·69	16800	4·5	1	0·516	48	1·4	0
10 A	0·695	—	—	2	0·41	76·5	1·4	0
							0·25	1
11 B	1·05	18200	6·1	1	0·325	121	4·55	0
11 A	1·06	—	—	2	0·149	251	4·2	0
							1·55	1
							0·7	2
12 B	1·43	20600	7·8	1	0·156	248	5·8	0
12 A	1·38	—	—	2	0·049	504	5·8	0
							3·0	1
							1·8	2
							0·85	4
13 B	0·58	19000	6·5	1	0·525	46·3	2·5	0
13 A	0·59	—	—	2	0·295	143	2·5	0
							1·0	1
							0·5	2
							0·3	4
14 B	0·77	—	—	1	0·355	103	3·6	0

else was probably owing to fogging of the photo plates. It is quite evident that even a good ammeter is useless for measuring the intensity of the rays, and if a spark-gap is also used it is too troublesome to correct the ammeter readings to allow for changes of the exhaust.

The leakage current is plotted against the intensity in Fig. 6. The points lie very well on the curve if chance errors, which can be explained, are allowed for. The straight line is not continued because the voltage across the gap, 600, was not sufficient to produce the saturation current with the more intense radiation. The ionisation and photographic methods are promising for measurement, but readings of electrical quantities in the secondary circuit are worse than useless.

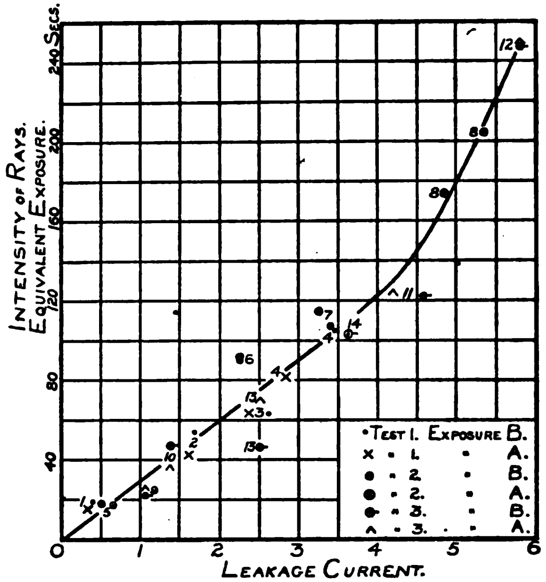

Fig. 6.

We have stated above that the rays were analysed after several of the tests. The results are plotted in Fig. 7. The curves show the fraction of the rays which had a definite penetration, and also how this value was affected by the hardness of the tube. It is necessary to consider both the spark-gap and the corresponding current in order to judge the quality of the exhaust.

So many statements have been made that the intensity of the rays depends on the voltage across, or current through, the focustube, that we ran two similar tubes in series and in parallel, to have the same current through or voltage across them, and exposed photographic plates to the rays from each tube. It was quite evident that there was no justification for the statements.

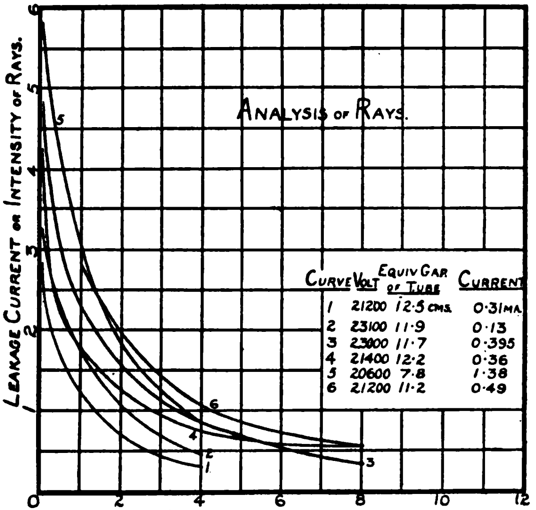

Fig 7.

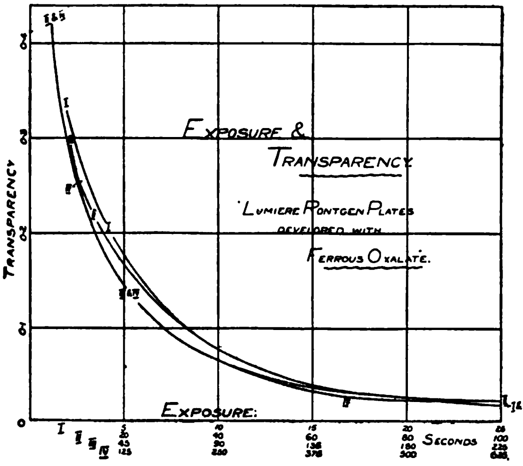

Fig. 8.

For the last set of experiments on ray intensity and exposure, stands to hold photographic plates were fixed at 10, 20, 30 and 50 inches from the centre of the anticathode of a focus tube. The intensities of the rays at the four points are in the ratio of 25 : 9 : 4 : 1. We had sufficient envelopes to make all the exposures for a set during the same run of the tube. The conditions were altered by using different makes of plates and alternative developers; but the results were much the same, one set being shown in Fig. 8, for Lumière Rontgen plates developed with ferrous oxalate. The scales for the exposure are arranged to correct the differencies in the intensities of the rays at the four points, so that if a definite photographic effect should accompany a constant product of ray intensity and exposure the curves should coincide. There are slight divergences from the rule, varying in direction; but, on the whole, it is fairly well obeyed even in extreme cases.

In conclusion we would refer any who wish to read more detailed accounts of the experiments to the *Journal of the Rontgen Society*, Dec. 1906, Feb. 1907, and April 1907.

On the Use of Stimulants, Narcotics, and Intoxicants among Uncivilised Peoples. By James W. Allan, M.B., C.M., Late Physician, Glasgow Royal Infirmary.

[Read before the Society, 7th November, 1906.]

ABSTRACT.

As the title of this paper indicates, I do not mean to refer to the drinking and drugging habits of modern civilised Society. The grim and terrible results of over indulgence in alcoholic liquors, and of the "opium," "cocaine," and "chloral," habits are notorious, and may well form a subject, not only for private anxiety, but for national consideration. . . .

The topic with which I mean to deal is the use of stimulants, narcotics, and intoxicants among primitive or uncivilised peoples. and my object is to show that the use of such agents is not confined to particular races, and is not peculiar to certain climates, but is widely spread among mankind. . . . I may say, by the way, that we in this country regard alcohol as *the* curse to which we owe so much misery—and without which all would be well. And with us in its abuse, it is undoubtedly a heavy curse. As to whether "all would be well" were it abolished, I beg to maintain a respectful, but sceptical silence.

In the following account you will find that there are many agents besides alcohol which are used by mankind for the purpose of obtaining pleasure, excitement, or insensibility.

I shall now pass in review some examples of the use of intoxicating beverages, and intoxicating drugs from different quarters of the world.

In *Europe*. . . . So far as I am aware, the little Lapps are the only race in Europe at the present day who can be spoken of as a primitive people. They have a vile fiery stuff called *finkel* (made from corn) in which they indulge. (Vincent). Speaking of the use of reindeer milk, Vincent says, "The whey is used for drink, and in some instances is fermented and distilled into an intoxicating spirit analogous to that called koumiss, which the Kalmucks make from mare's or camel's milk."

Asia. "Among the flora, however, of North-Eastern Siberia" (says Lansdell) "is a peculiar mushroom spotted like a leopard and surmounted with a small hood—the *fly agaric*—which here has the top scarlet, flecked with white points. In other parts of Russia it is poisonous. Among the Koriaks it is intoxicating, and a mushroom of this kind sells for three or four reindeer. So powerful is the fungus that the native who eats it remains drunk for several days. . . ." The Rev. James Gilmour, in his book entitled "Among the Mongols," has a chapter on "Whiskey in Mongolia." He describes how intoxicating liquors are obtained by fermenting mare's milk.

Africa. In Abyssinia, Sir Gerald Porter tells us there is a drink in use made from honey and water fermented with a bitter herb called *gesho*, or a bitter bark called *tsaddy*. It is a kind of mead in fact, and its use is confined to the aristocracy. It is forbidden to the common people. This beverage is called *Tedge*.

Commander Cameron in his book "Across Africa," refers to a drink used by the natives called Pombé, made from corn. "All hands managed to get drunk on their return, and a complaint reached me that they entered a woman's house and appropriated her pombé Bilâl, the younger made himself particularly offensive outside my verandah. And when I sent for Bombay in the morning he replied that he was sick, the truth being that he had a terribly bad head from over-indulgence in pombé."

With the exception of a few words on Mexico, I shall pass over *North America.* In the pages of Bernal Diaz you will find mention of a method of intoxication which I refrain from describing. Von Tempsky tells us in his "Mitla" (in a footnote). "Agave, the American aloe. In the North of Mexico a spirit is distilled from it called 'Mescal'; nearer the capital 'Pulke,' a half-fermented drink, is made of it."

In *South America* also we find intoxicants in use among the natives. Mrs Agassiz tells us that an inebriating drink is prepared in Brazil from the Mandioca root. In Peru are two remarkable plants referred to by Von Tschudi. One is the red thorn apple (*Datura Sanguinea*) from the fruit of which *tonga*, a very powerful narcotic drink, is prepared. The author gives an interesting account of an Indian under the influence of tonga. The other plant referred to by Von Tschudi is Coca (Erythroxylon Coca). Speaking of it, he says:—"He who indulges for a time in the use of coca finds it difficult, indeed almost impossible, to relinquish it. . . . It is a well-known fact, confirmed by long observation and experience that the Indians who regularly masticate coca require but little food, and, nevertheless, go through excessive labour with apparent ease. An inveterate *coquero*, or coca chewer, is known at the first glance. His unsteady gait, his yellow-coloured skin, his dim and sunken eyes encircled by a purple ring, his quivering lips, and his general apathy all bear evidence of the baneful effects of the coca juice when taken in excess."

The same author refers to a beverage called *chicha*. There is another beverage largely used in South America called Maté or Paraguan Tea. It is a stimulant but a harmless one, similar to our own tea.

In the Pacific Islands we find a drink called Kava, which is prepared in a disgusting way. "The habitual 'Kava' drinker," says Boddam Whetham, "may generally be recognised not only by his fishy eyes, but by the scaly appearance of his skin."

What is the philosophy of this strange propensity of mankind? The wide prevalence of the use of intoxicants and narcotics, from ancient to modern times, among savage and civilised peoples, and among races who had no communication with each other, demonstrates plainly that the practice has its root in a something which is not accidental or exceptional, but common to mankind. Doubtless this something is the altered attitude of mind which is caused by stimulating intoxicants, the "sweet oblivion" which is ushered in by narcotics, and the dreams and fantasies which follow the use of certain drugs. It is probable that, in some instances at least, the use of intoxicants had a sort of religious origin. Quotation from Mrs Philpot's book "The Sacred Tree." There is another aspect of intoxication which must not be overlooked, namely, its association with crime. It is well known that thefts and deeds of violence are frequently committed under the influence of drink; that is, if a man gets drunk, he may be guilty of an act which he would not commit if he had remained sober. But besides this accidental result, there are cases in which the criminal deliberately intoxicates himself in order that he may be capable of doing the deed. The man who weakly indulges in intoxication with a view to enjoying the delights of a paradise, very often ends by experiencing the torments of an inferno.

Beowulf. By FRANK BEAUMONT, B.A.

[Read before the Historical and Philological Section, 6th February, 1907.]

The history of the interpretation of this oldest of Teutonic romances is itself a romance of no mean interest. The uniqueness of the manuscript, its narrow escape from destruction, the strangeness of its poetic vocabulary, the devoted attention paid to it by isolated scholars in many lands, its tardy recognition as a valuable literary asset, the universality of the attention now paid to it by the apostles of modern language teaching, the huge output of comment, of conjectural emendation, and of translation devoted to it within the last twenty years—all add to the interest attached to its study.

Before entering upon the history of its interpretation, I ought, perhaps, to give you a brief outline of the story itself. The poem consists of a prologue, and forty-three cantos, the number of lines being 3182. The main body of the romance is divided into two parts, the incidents related in which are separated in time by a space of fifty years. The first part deals with the cleansing of Heorot, Beowulf's successful encounters with the merewife and her son Grendel. The second part relates Beowulf's fatal combat with the fire-drake that ravaged Gothland. Unity is given to the poem by the hero, but many scholars, chiefly German, have held that the two parts are distinct lays, by different authors. It is difficult, however, to find any real variation of style, and if this theory be correct, it must be held that the poem, as we have it at present, is the work of a single reviser, a shaper (or scóp) of old lays; a conclusion which is strengthened by the fact that a slight Christian veneer overlies the pagan tone of the poem.

The prologue tells of the famous race of the Spear-Danes, and their mighty king Scyld, in honour of whom they are sometimes called Scyldings. He was the son of Scef (Sheaf), and came to Denmark as an infant in a boat in which was a sheaf of corn. None knew how or whence he came. Many years he ruled the Danes as a prince should, doing many valorous deeds, great feats of arms, and lavishing on his vassals royal gifts, rings and jewels, armour and weapons. He had a son Beowulf, a worthy scion, who succeeded him, when the time came for the old king to go on his last journey. He went as he had come—alone in a boat, his own war-galley, filled with weapons and war-weeds, bills and his byrnies—while on his breast sparkled the royal gems. He was as well furnished by his "sorrowing folk as he had been by the unknown hands that sent him thither. With a gold-fashioned banner floating above him he sailed away. Who shall say to what haven he hied?"

Canto I. continues the story of Beowulf Scylding. It is to be noted that this Beowulf is not the hero of the poem, but one of the links in the mythical chain binding the ruling house of Denmark with Woden and his predecessors. His son is Healfdene, who reigns in his turn, and is then succeeded by Hrothgar. The reign of Hrothgar brings us down to the time of the poem. He becomes a mighty king, and, when his glory is established, it comes into his mind to build a great mead-hall in which he may feast his retainers. In due time it was completed—the greatest hall known to men—and he names it Heorot. It was fated one day to be burned by fire, but ere that time come it must be harried by the monster, Grendel. This fen-prowler could ill endure the light-hearted laughter, glee-song and harp strains that greeted him daily. [Here we have two of the Christian interpolations—one giving an old account of the Creation, and the other deriving Grendel, and all elves, giants, ogres, and sea-monsters from Cain.] At length Grendel came in the night-time, when the retainers were sleeping on the floor of the hall where they had drunk and sung, and seized thirty of the warriors, and devoured them. A cry of agony went up in the morning when the horror of Grendel's visit was fully perceived. The next night he returned, and the slaughter was repeated. Thereafter, when evening fell, the great hall was deserted, and men, brave in battle, were fain to creep timidly to the lodges and bowers of the women and children, which seem to have been immune from the monster's ravages. For twelve years King Hrothgar bore this terrible agony and suspense, during which time he lost many vassals, trapped and destroyed by the monster of evil. He worked his wicked will in the hall, but dared not touch, so the gods decreed, the royal throne. The King and his Council deliberated in vain. In vain they invoked their gods—the true God they did not know.[1]

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[1] The Christian editor again.

Then Beowulf, the Goth, is introduced to us. He had heard of Hrothgar's sorrow, and resolved to go to his assistance. He was stoutest and strongest of heroes then living. With fourteen chosen companions he set out for Heorot. The ship sailed like a bird, and in twenty-four hours entered the hythe of Heorot. The haven was separated from the hollow in which the hall was built by a high ridge over which a paved track led to the palace. On the sea cliff stood the royal coast-guard, who rode swiftly to the shore and challenged the strangers:

> "Who are ye men here, mail-covered warriors,
> Clad in your corslets, come thus a-driving
> A high riding ship o'er the shoals of the waters,
> And hither 'neath helmets have hied o'er the ocean?
> I have been strand-guard, standing as warden,
> Lest enemies ever anywise ravage
> Danish dominions with army of war-ships.
> More boldly never have warriors ventured
> Hither to come; of kinsmen's approval,
> Pass-word of warriors, I ween that ye soothly
> Nothing have known. Never a greater one
> Of Earls o'er the earth have *I* had a sight of
> Than is one of your number, a hero in armour."[1]

The substance of the hero's courteous reply is:

"I am Beowulf. My father was Ecgtheow, a warrior far-famed. Our intentions are not hostile. We have heard of the monster Grendel. I can help to free your king from the grisly creature." The coast-guard reminds Beowulf how easy it is to boast before the event, yet assures him of his trust in his good intentions, and promises to lead him to Heorot. Their boat shall be safely guarded. He leads them to the top of the ridge, whence Heorot is plainly descried. Then, wishing them God-speed, he returns to his duties as warden of the shore.

A paved causeway took them to the hall. Here they stripped off their armour, and, according to the old Teutonic custom, placed it with their weapons against the outer wall. The door-ward, with all courtesy, and commenting on their valorous mien, asked them who they were, and whence and why they came. The proud-mooded Beowulf replied: "Higelac's mates are we. I am hight Beowulf. My message will I give to thy prince and master." So the thane enquires of Hrothgar if he will receive them. Hrothgar remembers Beowulf as a stripling—had been friendly with his father Ecgtheow. It is here that we are told of Beowulf's superhuman strength—his war-grasp was mighty as that of thirty men. The strangers are ushered in by Wulfgar, and Beowulf salutes Hrothgar, and recounts to him youthful exploits as indicative of his prowess—such as his fight with the sea-nickers. "Alone now with Grendel I shall manage the matter. Grant me of thy bounty, O lord of the Scyldings, this single petition that I may alone, with my earlmen to back me, tackle this task, and purify Heorot. I have heard that the horrible creature useth no weapons. I, too, will trust in my handgrip, grapple with Grendel, body to body. Should he crush me, he will but devour me and my thanes, as *thy* thanes in Heorot. Send then my armour to my liege-lord Higelac. Wyrd must determine it." Hrothgar then welcomed Beowulf, and accepted his offer. He recounted to him all the horrors of Grendel's persecution, and how thane after thane had boasted himself, and afterwards failed and fallen. The strangers were called to the feast. The meed went round. The gleeman sang with a new heartiness. Danes and Goths rejoiced together. Then Unferth, body-thane of Hrothgar, arose in his cups and taunted Beowulf. "Art thou he that swam with Breca? 'Twas an idle vaunt and a vain adventure. Ye did it to humour your pride. Seven days ye measured the mere-ways, the angry billows, storm-tost by winter. But Breca outdid thee, won to his haven, and ruled his people. I ween thou shalt have less joy of thy grappling with Grendel." But Beowulf replied: "Friend Unferth, thou talk'st at random, befuddled with beer. We swam, 'tis true. 'Twas an old challenge, made in boyhood. We stuck together, and *had* not parted, but for the sea-floods. They drove us asunder. A sea-beast attacked me. After grim struggle my hand-blow slew him. I won to land there, the land of the Finns. Verily, Unferth, I never heard of exploit of thine that had any daring in it. Had thy acts been matched with thy vaunting words, it had long since gone ill with Grendel. He fears not the Danes—yet shall he fear the Goths. I warrant thee that from to-morrow all shall come unafraid and unmolested to the meed-drinking in Heorot"

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[1] From J. Lesslie Hall's Translation.

Then there was laughter of heroes—loud clatter of tongues. Wealhtheow, Hrothgar's Queen, herself played the hostess. She offered the cup to her husband first, and then took it from liegeman to liegeman, according to rank. Lastly she proferred it to

Beowulf, thanking God that he had come. Beowulf renewed his boast. Then mirth waxed high, till at last the old king rose to retire, leaving to Beowulf the care and keeping of the Wassail-hall. Danes and Goths stretched themselves on the benches and slept. But Beowulf watched and waited.

From his lair in the fens Grendel came stalking. He had heard again harp-strains in Heorot. Once more he would glut himself with blood. The door burst open, and he strode into the hall, exulting over his sleeping prey. Beowulf watched him closely, but in a trice he had snatched up a sleeping warrior, crushed his bones, and drunk his blood—devoured him even to the feet and hands. Beowulf, recumbent, seized him with his hands. Never had Grendel felt such strength. He would fain have fled, but Beowulf remembered his boast and held him still. Then the fight began. Up and down the hall they wrestled. The rafters groaned, the walls shook. From the over-turned benches the startled sleepers rose in amazement watching the battle. Grendel's cries filled them with terror. The hero, then, was fain of his strength, for Grendel's life was charmed—steel could not touch him. But Beowulf's hand-grip tore his arm from the shoulder, and the monster ran shrieking to hide in the fens. Beowulf nailed the hand with its monstrous claws to the wall of Heorot.

At dawn the warriors flocked from far and near to greet Beowulf. Some of them tracked Grendel by his blood to his home in the sea, caves beyond the fens. There they found the water dyed with his blood. Beowulf was the hero of the hour. Some, there were, who hinted at his succession to Hrothgar's throne, while nothing detracting from the old king's fame. The day was given up to rejoicing—to racing and vieing in sports. From time to time the gleeman sang of heroes; he descanted of the prowess of Beowulf, coupled his name with Sigemund's, slayer of a fire-drake, contrasted him with Heremod—he who became a burden to his people, and had to be expelled. None was so worthy of praise as Beowulf. Many henchmen stared in hall at the monster's hand. Thither, too, came Hrothgar and his Queen. In stately language the old king gave thanks to the young hero, who, in his birth had blest and honoured his mother. Henceforth he should be his son, warrior of deathless renown. With true heroic modesty Beowulf replied, happiest in that he had rendered service, regretful that the monster had not been wholly slain. Unferth stood by, abashed and ashamed—nothing he spake, for Beowulf's vaunt was accomplished. The king decreed a banquet, whereat gifts were royally lavished on Beowulf and his henchmen—a golden standard, well-wrought armour, rings and jewels, and eight steeds finely caparisoned. Wer-gild was paid for the slaughtered Goth. Then the harper of Heorot touched the gleewood, and sang the noble lay of Hengest the Dane's struggle with the Frisians—the great fight at Finnesburh. Then, again, the [1] skinkers went round with the cup. Wealhtheow, too, poured wine for her lord, praised his liberality to the Goths, but reminded him of his nephew Hrothulf, who sat beside them, natural protector, when need should come, of their two young sons. Then, in her own person, she thanked Beowulf for the cleansing of Heorot. Ah! little they knew that ere daybreak sorrow and terror would once more stalk through the palace. One there sat among them, who should never again see the light of the sun—Aschere, hoar and experienced, the king's trusted counsellor. The floor was once more strewn with the sleepers, when the mere-wife came, thirsting to avenge her son. Her entrance awakened the Danes. Swords were heaved, and the hag turned to flee. But fleeing, she seized Aschere, and dragged him to the fens.

Beowulf was not in the hall—he had slept otherwhere in the place of honour. He came at the summons of Hrothgar, and courteously asked him how he had slept. "Ask not of joyance," said he. "Grief is renewed to the Spear-Danes. Aschere is slain, my shoulder-companion, counsellor true." Then he told him of Grendel's dam, of her horrible home beyond the moors, and of her depredations. "Now is help to be had from thee, and thee only. Thou know'st not the place where the hag shall be found. Seek if thou darest. I will well requite thee." Beowulf bade him not yield to despair. Each must abide the day of death, and how could one die better than in the pursuit of glory? This adventure also he would achieve or die. So the old king and his people accompanied the hero to the monster's home by the sea-cliffs. There on the marge they came upon Aschere's head, and lamentation rose anew. The water was filled with nickers and sea-serpents, one of which Beowulf slew with an arrow. Then he prepared to plunge through the whirlpool to the monster's cave below. He donned his hand-woven mail, and took Hrunting, the sword of old fame that the repentant Unferth had lent him. He made a parting speech to Hrothgar, and besought him, should he not return, to be good to his liege-men, and send the gifts to Higelac, that his own king might see that he had not been wholly unworthy. Then he plunged, and the anxious warriors sat on the cliffs and waited. But a whole day passed, and the warrior did not return. Then, sick at heart, Hrothgar and his troop went moodily back to Heorot; but the twelve Goths sat on, and hoped against hope for the return of the master.

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[1] See Chaucer's "The Merchant's Tale," and Burns's "To a Haggis."

Meanwhile Beowulf had reached the mere-hag's den. She perceived his coming, and, clutching him to her, dragged him in, while many a sea-beast harassed and snapped at him. Well was it for him that his ring-mail and plate-armour were staunchly fashioned. Shaking her off, he smote her with the old famed Hrunting. But the sword would not bite—her skin was charmed. Flinging it aside, he trusted once more to his hand-grip, but the hag prevailed, and he fell beneath her. She struck at him with enchanted knife, but his armour again saved him. "Ah! he had died," reflects the Christian reviser here, "had not the Ruler of heaven more justly arranged it." He struggled to his feet again, and, observing on the wall of the cave an ancient giant-sword, the handiwork of elves, so huge that no man else could wield it, he heaved it high, and smote her on the neck. Thus she, too, died. Then he saw the body of Grendel lying, and smote off the head. Thereupon a strange thing happened—the blade of the giant-sword melted away, like icicles in the sun, so hot and poisonous was the blood of the monster. The waves of the haunted pool were stained with blood. 'Twas then that Hrothgar held the hero for dead, and departed with his troop. Of the jewels that were scattered so plenteously on the floor of the cave, Beowulf bore none away; he brought only Grendel's head, and the hilt, gloriously begemmed, of the melted sword. When he, despaired of, won back to the light of day, his henchmen's joy knew no bounds. They lightened him of his armour; four of them, so huge was it, carried Grendel's head on a pole.

Then the feast arose again in Heorot. Hrothgar heaped thanks upon Beowulf, who related his exploit, giving the glory to God. Hrothgar, in reply, recounted the story of his reign, praised Beowulf again, counselled magnanimity, and once more contrasted him with the niggardly Heremod. After more gifts had been showered on them, the Goths prepared to depart. They seek the hythe again, where their ship rides proudly at anchor, and, after Beowulf has rewarded the strand-guard with a jewelled sword, they sail for home. There the port-warden receives them gladly, and tells them the history of events since their departure, praising Higelac's noble queen, the generous Hygd, contrasting strongly with the shrew Thrytho, whom Offa tamed. At last they sit again at Higelac's board surrounded by their comrade Thanes, among whom Hygd and her maidens bear the mead-cup. The eager king presses Beowulf to a recountal of his adventures. So we have again the whole story of the cleansing of Heorot, but the repetition is justified by the way in which it is imbued with the spirit and personality of Beowulf, as noble in his modesty as in his courage. He lays all the gifts of Hrothgar at the feet of Higelac: "I bring them to thee, then, noblest of æthelings—offer them gladly: still unto thee is all my affection." To Hygd he gave the necklace of the Brondings that he had got from Wealhtheow.

Years only increased the affection of Higelac for his heroic nephew, whose widespread fame now amply requited him for the neglect and scorn of his youth, when men deemed him a trifler and a sluggard. And when Higelac died in a ripe old age, and after his son, Heardred, had fallen in battle with the Scylfings, Beowulf was called to rule the Goths. He ruled them fifty years, till a dragon, that guarded a treasure within an ancient barrow near the sea cliffs, began to ravage the land. A slave who had fled from his master found the barrow and its hoard, which the fire-drake had guarded for three hundred winters. He stole a gilded beaker, and took it back to his lord as a peace-offering. Then the lord and his retainers were led to the treasure-cave, and bereft the dragon of his hoard. When the theft was discovered the dragon snuffed along the tracks of the spoilers till he came to the inhabited land. Then he took a fearful vengeance, working havoc on the homes of men, till Beowulf, hoar and old as he was, resolved to rid the country of its terror. He determined to fight alone, but took with him to the barrow eleven companions, of whom his nephew, Wiglaf, was one. After a long retrospect, he bade them stay on the hill till the battle was over. Then he summoned the dragon to single combat, and the battle began. It is most realistically described, and the poetry suffers less than nothing by comparison with the dragon-fight verses in the Faerie Queene. In fact, I regard it as the father of the whole series of such descriptions in the mediæval romances, and the children are but a degenerate progeny. Finally, Beowulf's sword failed him, and he was reduced to dire extremities. His comrades fled in terror to the shelter of a wood—all save Wiglaf, who remembered his kinship. It is his first battle as a liegeman, but his courage shames that of his elders. He appeals to them to play the men. Rather would he die than go home without his lord. But he appeals in vain. Then he heartens Beowulf and comes to his assistance. His buckler of linden wood consumes in the breath of the dragon, but he creeps beneath the shield of his master, and from there deals the dragon his death-blow. But Beowulf has been mortally wounded. Before he dies he names Wiglaf as his heir, and requests him to bring out to him the hoard of the fire-drake that his dying eyes may be refreshed by the sight of it. When he sees the treasures he rejoices that God has permitted him to win such wealth for his people. Let the warriors prepare a huge bale fire for him on the edge of the sea-cliff, and raise o'er his ashes a mound that shall be seen afar by sea-farers, and that shall be known as Beowulf's barrow. So he died, and the ten came sneaking from the wood to gaze upon his corpse, and the dragon, and the treasure. With bitter taunts Wiglaf blames them for Beowulf's death: "No need," says he, "no need had the hero to be proud of his comrades." Then he sent a messenger to the Gothic leeds, who, as he went, gave voice to bitter forebodings of feuds to come with Dane and Swede, now that the mighty protector of the land was dead. Wiglaf commands that the hoard be destroyed—none shall have joy of it now that Beowulf is dead.

The poem closes with a graphic account of Beowulf's funeral pyre, and the last lines give the keynote of the spirit of the whole poem:

> "So the Goths bemoaned the fall of their hero, saying that he was the best of all kings under heaven, gentlest and most winning to men, kindest and friendliest to his liegemen, and ever desirous of men's esteem."

Such then in merest outline is the story in this our oldest national epic. But there is far more than story in it. It paints for us the domestic life, the sports, the feasts, the feuds of the rude forefathers of the English race, and this with a manly insistence on some of the nobler virtues—courage, generosity, love of land and kindred, respect for elders, self sacrifice, and (may I add) stern hatred of a foreign foe, along with a hearty condemnation of cowardice, boastfulness, and niggardliness. Hrothgar, Beowulf, Higelac, Wiglaf, would be an honour to any race, and their characterisation to any literature; while, as far as they are portrayed, Wealhtheow and Hygd are types of noble womanhood.

I claim for it the rank of "Epic." Artistically it may not reach the level of the Iliad or the Aeneid; its theme is not so vast, and it belongs to a ruder and more primitive literature. But it as far transcends the mediæval romances as it falls below the greater epics.

The boundary line between epic and romance is not definitely marked. They share, with history, a common origin. They all begin in tradition, and in the accounts that we have of other times it is not always easy to separate what is romantic from what is historical. Tradition that begins by being purely historical is sophisticated as it filters down through the ages, by pride of race, by love of the marvellous, by sacred mystery cast over it for their own ends by priests and rulers. It is sophisticated too by the anthropomorphic tendency—stories of natural fact become humanised, and thus myth is mingled with romance.

The natural medium of traditional stories of any length is verse, for it is easy to remember, is gratifying to the ear, and is more responsive than prose to the feelings of the narrator. The simple lays of the earlier and ruder rhymers are increased in length, amplified in detail and episode, adorned by rhetoric and enlarged by description as they pass to later and more cultured bards, until at last one man stamps the whole with the mark of his genius, and an epic is born. The epic is as much a higher form of literature than the romance as the tragedies of Shakespere are greater than the Chester mysteries. In epic there must be a union of art and ornament, proportion of parts and a satisfying whole, forceful and sustained characterisation, balance of action and reflection, verisimilitude combined with high imagination and transcending mere reality, grace of composition, fitness of vocabulary, a high and sustained purpose, nobility of theme, and fulness of detail without prolixity. All these virtues the great epics of the world's literature have taught us to demand. But a poem may fall short in some of these respects and yet remain epical; and perfection will depend very largely upon the state of literary culture in the poet's own age. It is in this comparative sense that I claim the Beowulf for an epic. Like the Iliad, it is the culmination of a romantic series. And like the Iliad it has its decadent followers. For, though the evidence is not direct and continuous, I think we may claim the Beowulf as the ancestor of the mediæval romances. It is easy for the epic to degenerate again into romance. Minstrels of less genius may readily spoil an epic lay by lack of restraint, by misplaced or excessive oration added thereto and clogging the action, by garniture with their own inventions of the extraordinary and the marvellous to arouse interest and sustain attention.

Now there are discrepancies in the structure of the Beowulf that have aroused much controversy and led to the spoiling of many reams of paper. Up to Canto 27, the poem shows complete unity and continuity. Even the episodes of the swimming match with Breca, and of the fight at Finnsburh, the contrast of Sigemund and Heremod, and that of Hygd and Thrytho, have a sufficient literary claim to the position they hold in the poem, if one is not blinded by a fanatic theory. But the latter part of the poem gives one pause. To begin with, the closing exploits of Beowulf are separated in time from his earlier ones by fifty years. Between the narratives of these we have certain cantos that appear to be in their nature transitional. They describe Beowulf's meeting with Hygelac, the latter's enquiries, and Beowulf's replies, in which he gives us, in a condensed form, the whole story over again of the cleansing of Heorot. Now, if the story as it stands is the work of the last shaper (or *scóp*) who made it epic, we have to justify this repetition from the point of view of art; and it seems to me that to this end one can only point out how the whole narration is suffused by the rich personality of Beowulf, as if it were intended to sustain and intensify the poet's characterisation of that hero.

There are other points that call for consideration. Heorot, Hrothgar's hall, is spoken of in the first part of the poem as fire-doomed, but, in the second part, it is Beowulf's palace in Gothland that is consumed by the flames during the Dragon's vengeful ravaging. One is tempted to think that in the original epic the Dragon episode belongs also to Denmark; that, as is hinted as probable in Wealhtheow's speech at the farewell banquet, Beowulf eventually became king of the Dane-folk, and that it was really Heorot which the Dragon burnt. Again, the second part of the poem is less artistically perfect than the first; there is less naturalness in the introduction of extraneous episodes; the balance between oration and action is not kept. As an example of oration clogging the action, we have the fairly long speech of Wiglaf which he makes between the moment when he recognises the necessity of going to

Beowulfs help and the time of his actual onset. One is thus tempted to think that a later minstrel has added the over-sea element to the domestic one, interpolating sufficient to take Beowulf to Gothland, keep him there as friend of Hygelac and Heardred, and later as king, and then closing with the original Dragon episode and death of Beowulf in a land not intended by the original author. Mr John Clark has suggested to me that the original domestic lay may have been made in Denmark, and the over-sea element added by a Northumbrian redactor.

It is an interesting question how far the mediæval romances are lineal descendants of Beowulf. Of course, these romances are not derived separately and alone from sagas. They owe much to classical legend and oriental fable, and to original invention—for every age has its own story. But they run in cycles, a body of related tales with some old hero lay as centre: the *Nibelungen Sagen*, the Arthurian tales, the lays of Charlemagne and his paladins. Thus the Nibelungen cycle has separate lays about Siegfried, Chriemhild, Hagen, Etzel (Attila, the Hun), etc. Interwoven with these we have the *Ostgotische Sagen* of Dietrich of Bern (Theodoric, the Goth) and his companions. Is Beowulf such a hero-lay centre? For one only of these mediæval romances has the direct ancestry of Beowulf been claimed, Sir Bevis of Hamton. Bevis is said to be merely a corruption of Beow. We have, however, absolutely no evidence of any connecting link between the two. The MS. of Beowulf, as we have it, was written in the eleventh century—Sir Bevis belongs to the thirteenth; and it is not at all probable that the author of Sir Bevis could have read Beowulf had he seen it. Yet many characteristic touches in Beowulf are repeated in Sir Bevis, suggesting that there is somehow or other a minstrel continuity. Did the lay of Beowulf live on through the centuries as a minstrel's tale? It is idle to ask. It is never mentioned in the extant Saxon literature. Surely Alfred or Aelfric would have referred to it had they known it. Yet, as I have before pointed out, the MS. is not older than the eleventh century. The language is that of Wessex, with slight traces of Mercian and Northumbrian. For instance, *merewioingas* in line 2921, which long troubled the editors, was identified by Grein as "the Merovingian," the Frankish king. This conjecture was verified by Bachlechner, who pointed out that the word follows the phonetic laws of the Northumbrian dialect. Thus the Frankish and West Saxon *Merewig*, would be in Northumbrian *Merewio*, just as West Saxon Answig is Oswio.[1] This is an outstanding example, but there are other Mercian and Northumbrian spellings, suggesting that the West Saxon copyist left alone those words for which he could not give a West Saxon equivalent. We may assume, then, that the writer of the MS. copied from an earlier Mercian or Northumbrian example. At all events, he did not take down the poem from the lips of a minstrel. That is proved by its archaic diction, which would be used by no minstrel in the eleventh century. The same fact goes to prove also what we have already assumed, that he was not the author but a mere copyist.

Every Beowulf student has had his guess at the authorship, but little has been proved, and why should we greatly care whether it first originated in Denmark, in Sweden, or in Northumbria? In its present form it is certainly English, and is interesting enough for its own sake. Apart from its story, it reflects for us the life and manners of an early Teutonic race, when clan feeling was still strong, for Hrothgar is more patriarchal chieftain than king. We see how they behave both in war and in peace. We sit with them at the feast, and, while the harp rings clear and sweet, we listen to the minstrel's tale. They have their sports as well as their feuds. And through it all is the gloomy fatality of the northern mind. Underneath the Christian veneer of the poet who gave us Beowulf as it is, we discern the old faith—a man maun dree his weird. "Gæth ā wyrd swā hio scel." Over and over again we find a new Christian sentiment cheek by jowl with this old heathen fatalism. Hrothgar ordered wer-gild to be paid for Beowulf's slain henchman, "whom Grendel had killed, as he would have killed most of them, had not the Providence of God prevented it, had not Wyrd (Fate) stood in his way, and the prowess of one man." This is characteristic, but the coupling of the divine with the human (the prowess of one man) is a commonplace of the later romances, and one of the conventions that Chaucer slyly ridicules in Sir Thopas:

Sir Thopas drew abak ful fast;
This geaunt at him stonës cast
  Out of a fel staffe sling:
But faire escapëd Child Thopas,
And al it was thurgh Goddës grace,
  And thurgh his faire bering.

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[1] See Earle's Deeds of Beowulf.

The influence of natural scenery upon the poet is also characteristically gloomy. Mountains are not once mentioned, but we have enow of cliffs, fens, lonely meres, sea caves, frozen sounds, with winter storms, and bitter winds. Hrothgar's description of the haunts of the fen-demons, which he has gathered from the tales of *fold-buende* (rustics), paints for us a landscape which is absolutely de-humanised, full of the terror of the north. Grendel and his dam "inhabit a remote land, with wolf-crags, and windy nesses and untrodden fens. There a dismal stream plunges from the rocks into the abyss of an underground pool. The mere is not far thence, and over it hangs a grim wood, its gnarled roots touching the water's edge. Nightly may one see there an awsome sight—fire on the flood. No son of man knows the depth thereof. Should the hunted stag be driven by the hounds to its shores, rather will he yield up his life on the bank than plunge into that hateful water. A horrible place it is! When the wind stirs up wicked weather, the waves rise black to the welkin, till the lift darkens, and the skies weep." Yet wild and awful as the sea is, the Northman loves it, and it is surely a significant thing that the first of all English poems has so much of the sea in it. It is a far cry (in time, but not in spirit) from Henry Newbolt to Beowulf.

It is noteworthy also that Grendel and his dam are not supernatural creatures. There is nothing ghostly about them. Our Christian veneerer derives them from Cain, and they are as human, in a monstrous way, as Caliban. It is because Beowulf recognises the human element in Grendel that he declines to arm himself for the conflict. Grendel scorns weapons, so shall his antagonist. Yet, taught by experience, he takes against the mere wife Unferth's proffered magic sword, Hrunting. The sword, mystic, wonderful, is another link with romance. Beowulf's own sword, with which he attacks the dragon, is Nægling. Arthur has his Excalibur, Siegfried his Balmung, and Roland his Durendal. This mention of Arthur reminds me of another interesting piece of evidence as to the continuity and inter-relationship of minstrel themes. After Hrothgar has concluded his praise of Beowulf, Wealhtheow, fearing that he may be tempted to name him as his successor, reminds him of their own two sons, whose natural guardian is his nephew Hrothulf. The poem speaks of Hrothgar and Hrothulf sitting side by side, uncle and nephew: adding, "up to that time, was their natural affection undisturbed, either to other true." This hints at another story—the treachery of Hrothulf. The story is not told, but is referred to as well known to the poet's hearers. It is uncle and nephew again in Arthur and Modred.

Let us take a typical passage, and translate it as literally as possible.

The street way was stone paved—the path led the men in a body. The war-byrnie shone, hand-locked hard, the bright ring-mail rattled on the heroes as they came marching on to the hall in their grisly war-trappings. Sea-weary, they set their broad shields, mighty hard bucklers, against the palace wall[1]; then sank they on the benches; the byrnies rang, war-gear of heroes; the spears, with the seamen's armour, were stacked together, ash-wood grey without; the iron-troop were graced by their weapons. Thereupon a haughty hero questioned the warrior-guests concerning their lineage: "Whence bring ye your gilded shields, grey sarks and helmets grim, your plenteous war-shafts? I am of Hrothgar herald and retainer. Ne'er saw I of strangers so many men of likelier mood. I ween ye have sought Hrothgar out of high valour, not with hostile intent but in noble-heartedness." Him the shelter of heroes answered, the proud lord of the Weder Goths spake word in response, bold under helmet: "We are table-companions of Hygelac. Beowulf is my name. I will deliver my message to Healfdene's son, the prince, thy master, if he will grant us to salute his majesty." Wulfgar replied (he was a lord of the Wendles, his lofty courage was known to many, his skill in war, and his wisdom): "I will question the lord of the Danes, the prince of the Scyldings, the ring-bestower, the illustrious chieftain, concerning thy journey, as thou beseechest; and the answer will I speedily make known to thee, which the good king consenteth to give."

Then went he hastily to where Hrothgar sat, old and very grey, amid his band of earls. He walked proudly, till he stood by the shoulder of the Danish prince; he was skilled in courtly lore. Wulfgar spake to his liege lord: "Here are arrived, come from afar over the circling sea, Gothic leeds; the warriors name their chief Beowulf. They are suppliants to thee, my prince, that they may exchange speech with thee; do thou not give them refusal of answer, kindly Hrothgar. They in their war-panoply seem worthy of earls' esteem; especially is the leader a doughty one, he who hath guided the warriors hither."

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[1] In accordance with immemorial custom. The porch was the "waepen-hus."

Then answered Hrothgar, the helm of the Scyldings: "I knew him as a lad; his good old father was hight Ecgtheow. To him did Hrethel of the Goths give his own daughter for his home; and now is his bold son come here, hath sought a friendly prince. The sea-farers told us, they who carried thither the tribute as a peace-offering to the Goths,[1] that in his hand-grip the leader of heroes had the strength of thirty. Holy God[2] hath sent us for a gracious help to the West Danes him in whom I have hope against the terror of Grendel. I will offer treasures to the hero for his bold-heartedness. Be thou in haste; bid the whole kinsmen-band together come into the presence—add these words eke, that they are welcome to the Danish leeds."

Then went Wulfgar to the hall-door, and through it gave the answer: "My victor-lord, prince of the East Danes, bids tell you that he knows your chief, and ye, bold of purpose, are welcome hither from across the sea-floods. Now may ye go in your war-weeds, wearing your helmets, into Hrothgar's presence; let your bucklers, your shields of wood, and your war-shafts abide here the issue of conference."[3]

Then arose the man of might, about him many a warrior, a noble band of thanes; some waited there, and guarded the accoutrements, as the chief bade them.[4] Together they hastened, led by Wulfgar, under the roof of Heorot; the high-hearted one went, hardy 'neath helmet, till he stood on the dais. Beowulf spake (on him the byrnie shone, the ring-mail linked by smith's cunning): "All hail to thee Hrothgar! I am of Hygelac's blood, his kinsman thane; many a wondrous feat I have wrought in my youth.[5] To me in my native land was this business of Grendel clearly made known; sea-farers tell that the hall, finest of buildings, stands vacant, emptied of every warrior, as soon as twilight hath hidden itself under the darkened sky. Then my folk, the best of them, stout carles, informed me of this, Prince Hrothgar, because they knew my strength and skill. They themselves had seen when I came from battles, a foe from against foes, where I had bound five, destroyed the giant kind, and slain nickers by night; where I had dree'd dire distress, wreaked the Weder feud (woes had they suffered), and ground them under fiercely; and now shall I *alone*[1] settle the affair against Grendel, against the monster, against the giant. Now, then, I will ask thee, Prince of the Bright Danes, Fence of the Scyldings, Shelter of Heroes, one boon only; that thou wilt not refuse, Noble Friend of the Folk, to me and my band of earls alone, this hardy troop, the cleansing of Heorot. Eke have I enquired and learnt that this monster in his heedlessness scorneth weapons. I too refuse then (so may Hygelac my master be fain of heart for me), to bear sword or broad buckler, yellow shield, to the conflict; but I with handgrips will wrestle with the fiend, and strive for his life, foe against foe. There on the ground shall lie, by God's doom, he whom death taketh. I know that he will, if he be given to prevail, devour fearlessly in the war-hall the Gothic leeds, as oft he has done the flower of the Triumph-Danes. Never shalt thou need to bury *my* head, but he shall find in me a grim combatant even though death take me: the lone ganger will bear a bloody meal, gloat o'er the savour, devour with joy as he makes for his moor-haunt; nor needest thou grieve long o'er the eating of my body. Send to Hygelac, if Fate take me, this best of war-shrouds, finest of life-fenders that covers my breast—it is a relic of Hrethel, handiwork of Weland.[2] Wyrd goeth ever as she must."

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[1] This assumption for the audience of familiarity with other lays is characteristic.

[2] This is not part of the Christian veneer. 'Halig' as an epithet is older than Christianity, and 'halig god' in the original could quite well be Odin.

[3] The old custom—helmeted and mail-clad as a mark of honour, weaponless as a sign of peace.

[4] Lest the excellence of the weapons should arouse the cupidity of the Danish thralls.

[5] This is not a boast, but a suitable prologue to his errand.

The whole of this passage is told with fine epic art. Beowulf's speech is long, but its length accords with the gravity of his errand—it prepares for the grim combat to follow. All through it breathes a high courage, and a quiet fatalism. This is not a solitary example. There are many fine passages, particularly in the first part of the poem—the cleansing of Heorot. The book is a literary treasure, and cannot be neglected in the study of English literature. Yet it is a treasure that has been opened to us fully only during the last thirty years.

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[1] "For honour travels in a strait so narrow,
Where one but goes abreast."
—*Troilus and Cressida.*

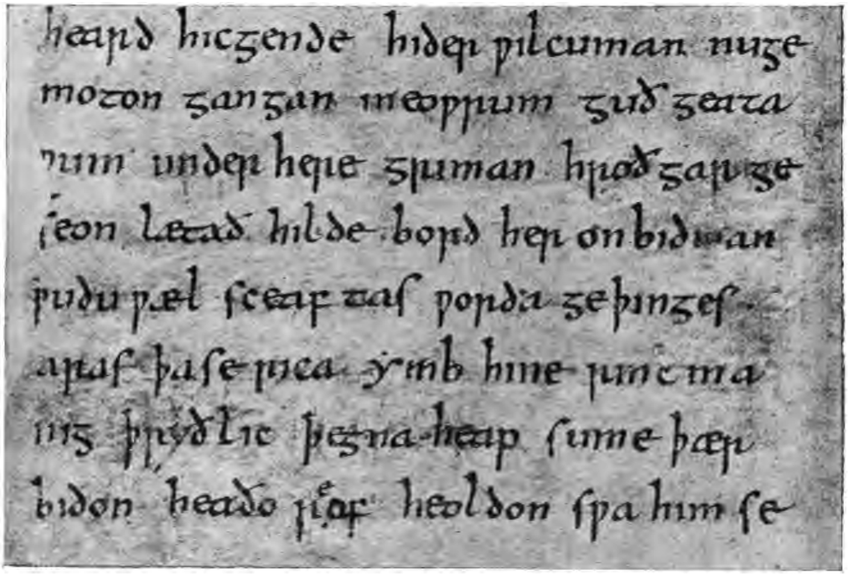
In all the chivalric romances honour must be individual, or it is not coveted.

[2] Sir Walter Scott's "Wayland Smith."

It is wonderful that we have it at all. The unique manuscript was one of those collected by Sir Robert Cotton (1570–1631), following the example of Archbishop Parker of Canterbury, who rescued many manuscrips from the scriptoria of the dissolved monasteries, and presented them to Corpus Christi College, Cambridge. The Cottonian Library was afterwards lodged in Little Dean's Yard, Westminster, and by a fire that occurred there in 1731, one hundred and fourteen MSS. were totally destroyed, and ninety-eight others (including the Beowulf one) were more or less spoilt. After inspection by a Parliamentary Committee the remnant of the collection (746 volumes) was removed to the old Dormitory at Westminster, and in 1753 to the British Museum. The *Beowulf* is contained in the volume marked Vitellius A XV., the ninth in order of ten manuscripts. The handwritings (for it is the work of two scribes, see plate), are beautifully clear, but, unfortunately, the edges of the parchment leaves are chipped and burnt away, some of the leaves being almost entirely destroyed. There is evidence that the scribes did not themselves understand what they were writing. They belonged to the tenth or eleventh centuries, and the archaic diction of the poem would be quite unfamiliar to them. It is often difficult to decipher whether the scribe intended one or two words. Some words are written as if they were two or three, while other words coalesce. There is little punctuation, and that little is unreliable, and there are no hyphens for compound words, and no length marks for vowels. Proper names are never marked by capitals, and capitals rarely occur even after full stops. The lines of the manuscript do not coincide with the verse lines of the poem. Hence there are many variations in the printed text. A splendid collotype facsimile of the manuscript was prepared for the E.E.T.S. in 1882 by Professor Zupitza, and this, for purposes of original research, is now of equal value with the parchment itself.

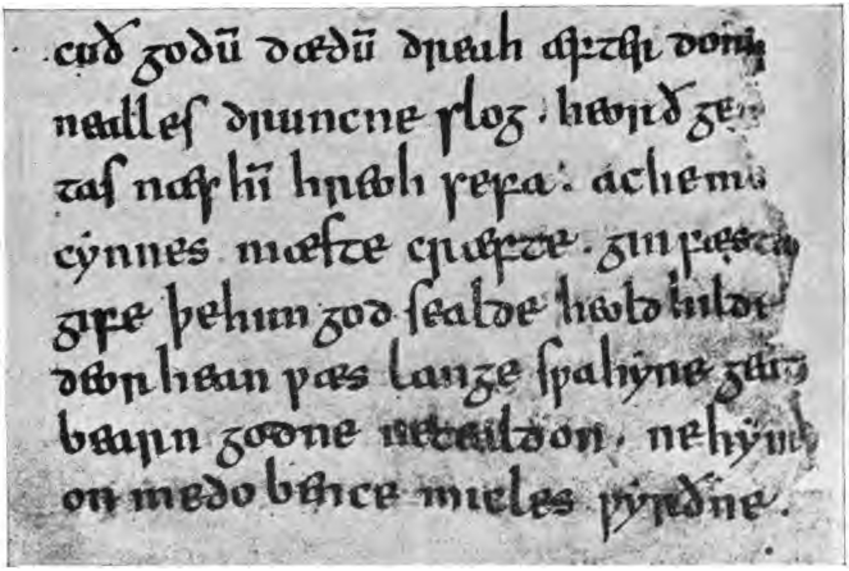
In 1705, Wanley was employed by Hickes to make a catalogue of Anglo-Saxon MSS. In the course of his searches he discovered the *Beowulf* in the Cottonion Library. This is the first time the existence of the *Beowulf* is ever mentioned. Wanley was the finest Anglo-Saxon scholar of his day, but his knowledge and experience were almost entirely confined to prose texts. In spite, however, of the faulty arrangements of the lines in the MS. he discerned that it was a poem, in fact he calls it—tractatus noblissimus poeticê scriptus. But how utterly incapable he was of

BEOWULF MSS.



heard hicgende hider ƿilcuman nu ge
moton gangan in eoƿrum guð geata
ƿum under here griman hroðgar ge
ſeon lætað hilde bord her on bidan
ƿudu ƿæl ſceaftaſ ƿorda geþingeſ
araſ þa ſe rica ymb hine rinc ma
nig þryðlic þegna heap ſume þær
bidon heaðo reaf heoldon ſƿa him ſe

SPECIMEN OF EARLIER HANDWRITING.



cuð godū dædū dreah æfter dom
nealleſ druncne ſlog heorð ge
neataſ næſ hī hreoh ſefa ac he m
cynnes mæſte cræfte gin fæſt
gife þe him god ſealde heold hild
deor hean ƿæs lange ſƿa hyne ge
bearn godne ne tealdon ne hyn
on medo bence micles ƿyrðne.

SPECIMEN OF LATER HANDWRITING.

reading it is shown by the fact that he describes it as dealing with the wars between Denmark and Sweden. As his discovery of the MS. took place twenty-six years before the disastrous fire in Little Dean's Yard it is a great pity that he was not moved to transcribe it. But regrets are vain, and we may rejoice instead that the Danish scholar, Thorkelin, had two transcriptions made of it, one by himself and one by a copyist ignorant of Anglo-Saxon, so early as 1786. At that time Danish scholars were printing and editing all their national and related MSS. on which they could lay hands, and it was in pursuit of this end that Thorkelin spent some months in London making his transcripts. He was strongly attracted by the poem, and devoted all the leisure of a busy scholar's life to its elucidation, preparing an edition which should comprise a text, a glossary, notes, and a paraphrase. In 1807, however, during the bombardment of Copenhagen by the British Fleet, his house was burnt down, with all its contents, including his work on the Beowulf. By good fortune his manuscripts were not in the house, and were thus saved. Urged by the entreaties and aided by the munificence of Johan Bülow, the Danish Privy Councillor, the old scholar set to work anew, a noble example of undismayed devotion. In eight years his work was again completed, and in 1815 appeared the Editio Princeps of the *Beowulf,* comprising a text, indices, and a Latin translation. His interpretation of the work was certainly wrong, but much value attaches to most of his work. He held that the poem was the work of an author contemporary with the events described, and that its present form was due to a translator who lived about the reign of King Alfred. He confused Beowulf, the hero of the poem, with Beowulf the Scylding, mentioned in the prologue, and by removing the suffix Wulf, identified both with Beow, the son of Odin. The Grendel and Dragon stories were, he said, Scandinavian myths. His knowledge of Anglo-Saxon, especially of the poetic diction, was very limited, but we count this as an advantage now, inasmuch as it guarantees the reliability of his transcripts, where these give us readings of parts which have long since disappeared from the friable edges of the MS. To this Danish scholar belongs, at all events, the honour of a pioneer. The advent of a second Danish enthusiast is marked by one of those bitter literary animosities which have accompanied the elucidation of many other old poems besides the *Beowulf.* As soon as Thorkelin's edition appeared, Nikolas Grundtvig, afterwards a pastor in the Danish Church, but then quite a young man, devoted close study to it. He contributed critical essays upon it to the Copenhagen Sketch Book, and among other papers was a translation of the Prologue, his interpretation of which was entirely different from that of Thorkelin. Thorkelin at once attacked the new worker furiously, declaring that certain incidents in his translation were not in the original, but were the fruits of his own vivid imagination, combined with ignorance. The learned world of Denmark took sides in the dispute, but Bülow recognised the merits of the young scholar's work, and induced him to set about preparing an edition and a translation of his own. For this he set himself, as he himself says, as ardently to the study of Anglo-Saxon as if he were to become a professor in that language. Such a study was then infinitely more difficult than now, as the knowledge of Anglo-Saxon was in its infancy, and there were few printed books in it. Grundtvig afterwards came to England, and studied the MS. at first hand, and many other MSS. also. His edition appeared in 1820. In it he offered many emendations of Thorkelin's text, and this before his having seen the MS. itself, and the great majority of his emendations were afterwards found to be identical with the text, a fact which speaks wonders for the thorough mastery of the old poetic diction that he had attained by his studies. Grundtvig gave many incidents of the story that Thorkelin had omitted, such as the sending to sea of Scyld's body, the sorrows of Hrethel, the heroic struggle of Hnaef and Hengest at Finnsburh, and he it was who first enabled us to place the period of the action by his identification of Hygelac with the Chochilaicus of the Chronicle of Gregory of Tours.

In the meantime the *Beowulf* poem had attracted the attention of a solitary scholar in England—Sharon Turner, the historian. He quoted it in 1807 as a triumphant refutation of the theory of the school of Ritson who maintained that Romances were not found earlier than the Norman Conquest. But his inability to read it is sufficiently shown by his making Beowulf come from Gothland to wreak a deadly feud on Hrothgar. After reading Thorkelin's edition, however, he was better able to appreciate the work, and he translated several passages for use in his history of the Anglo-Saxons, which appeared in 1823.

In 1826, Jno. J. Conybeare, in his "Illustrations of Anglo-Saxon Poetry," published for the Society of Antiquaries, gave a full description of the poem, with some metrical translations, and specimens of the Anglo-Saxon. His preface is interesting in that he combats the theory of Turner that the poem had been made by a scóp contemporaneous with the events, maintaining rather that the frequent formula, "as I have heard say," referred to tradition and not to narration.

The first English edition of the *Beowulf* text appeared in 1833. It was the work of John M. Kemble, a graduate of Trinity College, Cambridge. It included, also, a glossary of the more difficult words, and an historical preface in which Kemble tried to solve the problem as to the reality of Beowulf and the other characters as historical personages. He took from Saxo Grammaticus the fact that Hrothgar reigned in Denmark in the fifth century, and decided that Beowulf was an Angle who left his own country to enter the service of Hrothgar. But in a second edition of his work, which appeared in 1835, Kemble rejected all his former historical conclusions, and studied the poem anew from a mythological standpoint, thus anticipating almost the whole course of modern commentary. In a new edition of the work, in 1837, which included a translation into English prose, a fuller glossary and philological notes, Kemble emphasised and enlarged the views that he had stated in his second preface. He recalled the fact that all the races of the old world traced the pedigrees of their kings to the gods. Just as the Greek royal families were all sprung from Zeus, so all Teutonic kings were descendants of Odin. But every individual royal-house had its own particular divine progenitor, either more or less remote in the genealogies than Odin. A study of the ancient Saxon genealogies as preserved in MSS., enabled Kemble to trace the divine pedigree fifteen stages above Odin, and the seventh, eighth, and ninth places are occupied by Sceaf, Scyld, and Beow respectively. These are the three names in the *Beowulf* prologue, and Kemble maintained that Beow and Beowulf are really the same names, and, since the name Beowulf never occurs in any historical record, he held that the mortal exploits of Beowulf, son of Ecgtheow, the hero of the poem, were really a legendary transformation of the deeds of Beow the God—that, indeed, Beow the God, and Beowulf the Scylding, and Beowulf the mortal hero were essentially and originally one. Geat, now translated Goth, he derived from Geotan = to Pour. Hence Geat = God of abundance = Odin. Most of Kemble's conclusions are now the common places of *Beowulf* criticism, but in his own day they were startlingly new. His glossary, too, was the finest thing of its kind yet done, and it remained the standard until it was replaced by Grein's *Sprachschatz*, which itself took Kemble's work as a basis.

Next the *Beowulf* fell among the Germans, and there quickly followed a mass of criticism and counter-criticism, theory and refutation, emendation and commentary, disquisitions on the minutest point of spelling, or metre, or interpretation, which would render the work of a conscientious bibliographer a by no means easy task. Yet among much that is useless the best work of the German scholars has transcended that of Englishman, or American, or Dane, and to Grein and to Heyne especially all Beowulf students owe a large debt of gratitude.

The first German publication was a mythological and historical analysis by Heinrich Leo, published at Halle in 1839. He held that the poem was mainly heathen, with slight Christian modifications, such as the replacing of the names of the old gods by such terms as Hælend, the Saviour, and Wealdend, the all-ruler, etc. The story is mythical, with historical additions, such as the part of Hygelac. The Geats he identifies with the Jutes. He denies an English origin for the poem, suggests that it arose in Angeln, in Schleswig, and was brought over here towards the end of the Anglian immigrations. He ascribes the excellent preservation of the poem to the fact that it was early removed from the land of its growth, and became fixed, like the Icelandic Sagas.

In 1840, Ludwig Ettmüller of Zurich published a translation of the poem into archaic German. In his preface he maintained that the Geats were the Goths of South Sweden. He pointed out that the names Angle and Saxon never appear in the poem, and he, in consequence, ascribed to it a continental origin, holding that it was brought over to Northumbria in the eighth century by early Danish settlers, and that it was then put into vernacular English by a layman, whose work was afterwards revised by a Christian. (In this connection one may note the theory advanced by Mr. Stopford Brooke that Geatish settlers landed on the banks of the Forth in the sixth century, and brought the lay with them. I do not know his historical authorities for such a landing, but Bede always calls the Jutes of Kent Geats. Were these Jutes from Jutland (as we are usually told) or Goths from Gothland? If Goths, would their national epic be *Beowulf?* They were not Saxons, as their bitter enmity proves.) He is the first of the Germans to subject the poem to the destructive criticism that we usually connect with the names of Wolff and Lachman, in dealing with Homer and the old epics. He maintained that the poem was an accretion of various old lays, redacted first of all by laymen, and afterwards by clerics, and in his translation he showed by means of a set-off in his type what passages he ascribed to the former, and what to the latter.

We again find the poem attracting the attention of Englishmen, for in 1849 there appeared a translation of the poem into English verse by A. D. Wackerbarth, published by Pickering. Like Kemble the author identified Beowulf with Odin.

Six years later appeared the work of Benjamin Thorpe, published at Oxford by John Henry Parker. It was entitled "The Anglo-Saxon Poems of Beowulf, the Scóp or Gleeman's Tale, and the Fight at Finnsburg, with a literal translation, Notes, Glossary, etc." This was the book which remained for long the text-book of English students. It was printed in half lines, with translation parallel, and contained more blanks than modern text-books, because, of course, the defective passages had not yet been filled up by German emendation. It was the first book on *Beowulf* that I ever possessed, and somehow or other charms me more than the rest. Some of the fascination lies in the quaintness of the half line typography. In many respects it was the best work on the subject yet published. It had taken twenty-five years to prepare. He began it when resident in Denmark, and in 1830, when he returned to England, he collated the original MS. with Thorkelin's text, so that his text is of even greater value than that of Kemble's, seeing that every year the friable MS. became less and less perfect. His theory of the origin of the poem is that it was not an original product of the Anglo-Saxon muse, but a metrical paraphrase of an heroic Saga composed in the south-west of Sweden in the old common language of the north, and brought to this country during the sway of the Danish dynasty, that is in the eleventh century. From the allusions to Christianity contained in the poem, he does not hesitate to regard it as a Christian paraphrase of a heathen Saga and these allusions as interpolations by the paraphrast,

Very different is the theory of Daniel Haigh, who in 1861 published "The Anglo-Saxon Sagas: an examination of their value as aids to History: a sequel to the History of the Conquest of Britain by the Saxons." He claims the *Beowulf* as the work of a Northumbrian *scóp* familiar with the scenes described, and acquainted with those who had actually known the heroes of the story. With him, Sceaf, Scyld, Beow, Hrothgar, etc., were not myths, but real men living, or having lived, in Northumbria. He identifies many place-names with the personal names in the poem; *e.g.*, North and South Shields with Scyld, as also Shilbottle, *i.e.*, Scyld-bōtl, the palace of Scyld. Heorot is Hart, in Durham. The mere is Hartlepool, of which the borough arms have a hart standing in water. Connected with Beowulf we have Bowlby Cliff, near Whitby, and Bolton on-Alne, the old Latin name of which was Beolvelaunio. Near Hart he finds an ancient fort, a battlefield, and barrows containing the bones of men of gigantic stature (150 in one grave). He finds traces of Ingeld's principality in Ingleby, Ingleton, and Ingleborough, of Grendel in Grindleton, Crindale, and Grendon. He takes *Scedelandum* to be, not a proper name, but the "shedded lands," *i.e.*, the two Sunderlands, one in Durham, one, less known, in Northumberland. In the same way he identifies the land of the Weder-Goths with the East of England, with Suffolk, finding in place-names there relics of Hrethel, of Hygelac, and of Hygd. Hygelac's home he places at Uggeshall, in Suffolk. That Ongentheow was called King of the Sweons does not decide that there were no settlements of Sweons in East England. He claims that Hygelac's descents on the Franks, as recorded by Gregory of Tours, could have been better made from East England than from the Baltic. He identifies Thrytho in the poem with the first wife of Hygelac, and the widow of Offa the Angle, whom he states to be that Offa of Mercia who fought against Alewih the Saxon. As to Beowulf's swimming match with Breca the Bronding, he makes Breca a near neighbour of Hygelac, and cites such names as Breckley, Brondston, and Brandon, all in Suffolk. Beowulf's voyage then was from Lowestoft to Hartlepool, 200 miles, which at six miles an hour would be done in the two days of the poem. Beowulf's barrow was made on Hronesnæs, which Haigh identifies with Runswick, a village near Bowlby, *i.e.*, Beowulf's-burh. Haigh's arguments are most ingenious, and his work is extremely interesting, but he has made no disciples, for all his place-names can be otherwise and more reasonably explained. It may be mentioned in this connection that Professor Henry Morley, while giving the poem a Danish origin, believed that the scenery descriptions as we have them are English and the work of a Northumbrian reviser of the old lay.

In 1857, there was published at Göttingen a Text and Translation, and in 1867, at Cassell, a Text and Glossary of a collection of A.S. poetry, both being the work of C. W. M. Grein, a distinguished graduate of Marburg. Grein and his master, Professor Dietrich, represent the conservative reaction in Germany against excessive emendation of old texts, and his text of the *Beowulf* is nearer to the readings of the original manuscript than any other, with the exception of Wyatt's, and shares with that of Maurice Heyne the honour of having been freely used as a basis by many other editors and translators. The work of Grein, as textual critic, as philologist, as metrist, as commentator, and as explainer, is easily first in the Beowulf roll of honour. To the 1867 edition of his two volumes, Grein added an Historical Preface in which he gives a sketch and resumé of all the Beowulf literature up to his day. In his explanation of the poem he was more historical and less mythological than his predecessors. He held that the hero was historic, but that many of his adventures were mythical. He identified two populations, the Danes and the Goths. The Danes were called East or West, or North or South Danes indiscriminately, and sometimes Ring Danes (from their chain-mail), Gar-Danes (from their spears), or Briht-Danes (from their shining armour). The seat of the Danish kingdom is Saeland (Zealand). Heorot is Hjort-holm. Opposite, on the Swedish coast, is Bo-hûs, *i.e.*, Beow's or Beowulf's house. The fights of Haethcyn, of Hygelac, and of Hengest are all historical. The Grendel, Breca, and Dragon stories are myths attached to actual historic persons, and brought to England from Saeland in the sixth century.

Moritz Heyne's Text, Glossary, and Translation were published at Paderhorn in 1863. Like Grein's, his text has been much used as a basis by other workers.

In his Marburg Dissertation of 1862, Grein stated his view of the authorship of the poem most explicitly in the words, "I hold this poem, as it lies before us, for the connected work of a single poet." . This led to a bitter attack on his work by an anonymous critic, who ignored its great and outstanding merits, and concentrated his attention most harshly on the imperfections, slight as they were, of the books. Grein soon identified his opponent as Karl Müllenhoff, a man whose work on the *Beowulf* was to rival in fame that of Grein himself. He was a devoted adherent of the Wolffian theory as applied to all old poems, and his excessive reverence for the theory blinded him to the merits of all who opposed it. It is unfortunate that his relations with other *Beowulf* scholars were marred by this literary acrimony, for, next to Grein, he has done most for the elucidation of the *Beowulf*, in spite of the fact that his conclusions as to the origin of the poem meet with little acceptance amongst present scholars. The patient research that he devoted to the poem told beneficially in many ways; and one may assert quite truthfully that, before he published the results of his studies, he must have known every jot and tittle of the text of the *Beowulf*. He himself speaks of his theory as quite simple. He first separates the Grendel story from the Dragon story. Thus we get authors A and B. Then he marks off the Grendel portion proper from that of his dam, the latter being ascribed to a third author C. He carefully fixes the lines of demarcation, and produces what he considers conclusive evidence of variation in style. The Finn and the Breca episodes he subtracts from the poem, and assigns them to two new authors, D and E; and his sixth worker at the poem is the final reviser, who removed the reference to Teutonic gods, and gave the poem its Christian veneer. All this he does with an air of infallibility, and much of what he gives as conclusive proof is mere guess-work of his own. The worst of it is that his own confidence in himself is apt to put the reader off his guard, render him uncritical, and prepare him to accept improbabilities as facts. In his own time Müllenhoff had many disciples, but his methods are now largely discredited. Hermann Möller afterwards extended and amplified his theory. He rewrote the whole poem in strophes of four-lined ballad stanzas. To do this he had to reject much material here and there, but the chief story remains clearly told. What Müllenhoff had selected as interpolations, Möller found himself unable to bring under his arrangement, and this fact he offers as bearing out the theory; but this kind of tampering with a text may be made to prove anything, if one's method be only sufficiently elastic.

All this time Grundtvig of Denmark had continued the work of his youth, and in 1861 he published an edition of the text, with an introduction, and critical notes written in Danish. This edition is noteworthy for the number and the audacity of its conjectural emendations. His early and triumphant success as a mender of Thorkelin's faulty text seems to have made Grundtvig believe himself infallible in his new suggestions, but practically none of them have been accepted by later scholars. Students of old literatures, and especially of the classics, were beginning to tire of the mass of variant readings and suggested textual improvements with which every edition was overloaded. Lovers of pure letters were beginning to resent the air of superiority worn by those scholars who felt immense pride in themselves for having replaced a "b" by a "t," or discovered in some obscure MS. a new form of a long accepted word. The tendency has been to adhere more firmly to old texts as they stand, though to commonsense emendations sufficient welcome has been given to prevent the tendency from hardening into a pedantic dogmatism.

In 1876 there appeared the first edition of the *Beowulf* as yet prepared by an Oxford man. It was by a Fellow of University College, Thomas Arnold, who had previously edited the English works of Wycliffe. It is interesting as being the first of English editions to make use of the long line, instead of the half-line, as had been customary in all the Danish and English texts. The new fashion was a German one, and it has persisted to the present day. In his literary introduction Arnold advances a new theory as to the origin of the poem. He refers to the visits of English missionaries in the eighth century to Friesland and Denmark for the conversion of their heathen relatives, and mentions Willibrord, whom the King of Denmark permitted to take thirty young men to Friesland to receive a Christian training. These young men, Arnold suggests, brought with them mental stores of lay and legend, from which Willibrord or some other ecclesiastic selected the incidents which he wove into the Romance of Beowulf. This, it will be seen, is in flat opposition to the German theories, ascribing, as it does, the whole work to a single (Christian) author.

In 1881 there appeared a new edition of Grein's Bibliothek of Anglo-Saxon Poesie, re-edited by Richard Wülcker—this, known as the Grein-Wülcker, is still the standard text on the Continent. Wülcker, in 1885, published his *Grundriss*, a work indispensable to all *Beowulf* students on every side of the question—textual, historical, etc. It is a resumé of all the best work done on the Beowulf from the days of Thorkelin. The first American edition of the text was that published in 1883 by Professor Jas. A. Harrison, of Washington and Lee University, and Professor Robert Sharp, of the University of Louisiana. Both had been students at Leipzig, in accordance with the admirable fashion that prevailed among American post-graduate students—and there they had become familiar with the German studies of *Beowulf*

Their text is based on that of Maurice Heyne, and although it displaced Thrope's for school and college use, and long held the field undisputed both in America and in England, it did so in spite of, certainly not aided by, its annoyingly pedantic arrangement of the glossary according to certain more or less fanciful German philological theories.

In 1884, Dr Rönning published in Copenhagen a very full treatise on *Beowulf* and *Beowulf literature.* He takes pride in the fact that Denmark had given the learned world the first transcript of the MS., the first edition of the text, and the first complete translation of the poem, but regrets that she had since neglected the work, and yielded place to Germany. He opposes the theories of Müllenhoff and Ten Brink, using their own selected passages to refute their conclusions. Like Haigh, he ascribes the poem to a Northumbrian ecclesiastic, but finds the cradle of the song in South Sweden—the workmanship is English, but the material is not.

Probably the most interesting of all English publications on the subject appeared in 1892. It is entitled "The Deeds of Beowulf, an English epic of the eighth century done into Modern Prose," by John Earle, M.A., Rector of Swanswick, and Rawlinsonian Professor of Anglo-Saxon in the University of Cambridge. It consists of an Introduction in three parts, a complete Prose Translation, and a body of excellent critical and illustrative notes. In the first part of his introduction he gives a short history of *Beowulf* criticism; in the second a synopsis of the poem with illustrative extracts translated into Old English metres; while in the third he works out his own theory of the poem. He had published the main points of his theory as early as 1884, but in this work he marshals his evidences with great care and fulness. Kemble had supposed the poem to be Anglian because of the mention of Offa of Mercia. Earle makes this the central point of his study. He first argues that the poem is largely didactic, selecting certain passages as what he calls monitory passages. In fact he calls the poem, "The Institution of a Prince," an admirable title when we remember the essential nobility of Beowulf's character. But when he goes on to discover the prince for whom the poem was composed as a lesson-book, it is not so easy to agree with him. With much ingenuity (but more fancy) he argues that this young prince is Ecgferth, the son of Offa, that the author of the poem and monitor of the prince is Hygebriht, Bishop of Lichfield, that the good Queen Hygd is mentioned to give the key to the poet's name (Hygd suggests Hyge), that Thythro, the shrew, is really Cynethryth, Offa's Queen, and that the worthy bishop introduces her here to work off some animosity or other that he has conceived against her. The Bacon-Shakspere craze is not much worse than this. Most critics treat the Offa story as an episode—one of the last of the interpolations, and probably introduced by the minstrel who sang the old lay at the court of Offa—an episode of the Taming of a Shrew, in which Thythro is the Katharine, and Offa the Petruchio. It is a minstrel theme with traditional continuity right on to the days of Matthew Paris, who calls the Shrew Drida—of wondrous beauty but ungovernable passions, condemned to death for some nameless atrocity, but reprieved, and cast adrift on the sea, which carries her to Offa's shore, where her distress and beauty move him to love and pity. When she recovers her health her violent temper returns, but he marries her, and tames her. Do we have here the real origin of the theme of Shakspere?

The latest text to receive the approval of scholars is that of Alf. J. Wyatt, of Cambridge, published by the Pitt Press in 1884. It is admirable in every way, and may be regarded as the standard English text. The glossary is built on common-sense lines, and —a useful innovation—those words in it which have modern English derivatives or representatives are printed in a heavier type. The text follows the MS. as closely as possible, every variation being shown in a foot-note, to which the editor has also relegated those conjectural emendations which, though he rejects them himself, are to be found in the Grein-Wülcker or Heyne-Socin texts.

The "Innere Geschichte" method of studying the poem, as represented chiefly by Müllenhoff and Ten Brink, has to proceed chiefly by circular arguments on variations of language or style or structure which are just as easily explained by the fact that the lay was the work of an unliterary age, and had a long oral and traditional life before it was fixed by writing. The method is now discredited as futile and unproductive, but the study of the poem on a mythological basis is still a favourite one, and a fascinating one, especially when the methods used are those of comparative mythology. Yet here, too, there is danger of excessive fancifulness, and a tendency to make mountains of mole-hills. And here, too, the work is largely German. Jacob Grimm identified Grendel —deriving his name from *grindel* (a bolt), while Loki is from *lukan* (to shut in, to lock)—with Loki, the Teutonic God of Mischief, his sea-cave resembling the river-home of Aegir. Beowulf was Bee-wulf, the wood-pecker or honey-hunter, and as in classical mythology, the *picumnus*, or pie, is placed in the race of Kronos, Zeus, and Hermes, who corresponds to Geat or Odin, therefore Beowulf is Odin. Grimm's philology, however, is too fanciful. Kemble suggested that Beo was *bewod*, a knife, and hence that Beowulf was Beow, the God of Harvests. Müllenhoff derived the name from *bauen*, to build, and he sees the myth of the coming of civilization in Sceaf (sheaf), and Scyld (shield, or man's defence). Their descendents were Beaw (builder), and Taetwa (tiller of the soil). All four he holds to be one, Freyr, God of the Fields and Sea. The hero, Beowulf, is also Freyr, and the swimming match with Breca is Freyr's annual strife with winter storm (for they swam towards the north), and their swords signified that they were to conquer the north wind. Grendel is the god of the wild sea, of the spring-tides, and his subjugation signifies the resistance of man to the sea's ravages on the low German flats. The Dragon represents the equinoctial gales. Beowulf is then old—the winter of his days is approaching. The heroic life is the summer between these periods of storm and stress, and his victorious death saves the land from lasting ruin (and is enacted annually). Skeat once argued that Grendel was a personification of the polar bear. Grendel means grinder. Like the bear, he uses no weapons, but relies on his grip. He is carnivorous, his hands are furnished with claws. He dwells in a sea-cave, swims, seeks his food by night, keeps always the same den—so does the polar bear. The philology is sound, and the argument is plausible, but, what of it?

Henry Morley suggested that the poem is a transformation into myth of conflicts with plunderers and harriers—Grendel and his dam are successful enemies in a feud—the dragon was one who had harried the land with fire and sword. In tradition, the human becomes superhuman—history becomes myth.

Stopford Brooke, in his Early English Literature, devotes a complete chapter to the mythical elements in *Beowulf*, and tries to connect it with the whole body of northern myth by finding parallels in the Grettis Saga, but his treatment of the subject is too nebulous to be satisfying.

To Uhland Grendel was a pestiferous swamp on a low, bleak coast. Laistner extended this idea. He derives Beow from

Maeso-Gothic *Bangjan*, to cleanse, and *Wulf* means mist. Therefore, Beowulf is the mist-cleanser who frees the dwellers in Heorot from the malarial mists represented by the attacks of Grendel. The swimming match is between the south wind and the ice of a northern winter. Breca is the Breaker, ruler of the Brondings, *i.e.*, the brands or rays of the hot summer sun. Regarding the theories of Uhland and Laistner Professor Morley wittily suggested that the ultimate solution of the myth is evidently to regard Beowulf as a civil engineer, or at all events a drainpipe. We may, I think, accept the suggestions of Karl Müllenhoff that, if the Beowulf stories are myths at all, they represent the play of the opposite forces of Nature, beneficent and maleficent, one against another—that they represent the dim, half-groping attempts of thinkers in a rude, far-off, unlearned age to reconcile the facts of human life as they observed them with the huge inexplicable power of Nature.

I will close with some remarks on the translations of the poem. These divide themselves into three classes:—(1) Translations in prose, (2) verse translations in modern metres, (3) verse translations in which the translator attempts to give the reader, as nearly as possible, the rhythm and style of the original. Of the first it may be said that all, both in English and in German, are satisfactory, with the exception of those which try to catch the old flavour by mingling the archaic with the modern. These translators offend, because, as Ben Jonson said of Spenser, "in affecting the ancients they writ no language." The same fault may be found in most of those who have used method number three. It would be hard to find language which, when read aloud, sounds more un-English. Yet they are loud in their denunciation of those translations which are frankly modern. They hold that blank verse and ballad measures can never reproduce the charm of the original rhythm; but one may pertinently ask if the ordinary reader is likely to be charmed by old rhythms if in every line he suffers a mental shock from the language; and surely translations are primarily intended for the ordinary reader, and not for the Anglo-Saxon student—the latter will go to the original for its charm. After all, one is brought back to the old dictum, that the atmosphere, if I may call it so, of a poem is untranslatable.

Anglo-Saxon verse was spoken, or chanted, long before it was written, and, like all Teutonic verse, is characterised by the fact that *accent* always corresponds with *arsis*, or rhythmic beat. *Quantity* is alien. In every verse there are eight *arses*, and the three most strongly accented words, two in the first half verse and one in the second, are alliterative. Sense-endings and verse-endings do not always coincide. The sense often ends in the middle of a verse, and in this case, alliteration acts as a connective, linking the meaning of a new sentence to that which closed in the previous half-verse. Much licence is allowed as to the number of unaccented syllables which may be used in addition to the eight *arses*. The rhythm is by no means a jingling one—it is a stately measure, which may be moved to a forceful rapidity by stress or ardour of feeling. Its development into the Middle English metres like that of Bevis of Hamtoun, or that of the Tale of Gamelyn (the metre of "Sing a Song of Sixpence") was not uninfluenced by French forms, or one might have looked for a fitting medium in the ballad stanzas and tetrameters of the Romancers and their modern prototype, Scott. It may be argued that these are not sufficiently dignified, but at all events the man who could skilfully wield and skilfully vary, when needed, the measure of Tennyson's Ballad of the Revenge, would, to my mind, make an admirable translator of the *Beowulf.*

Several verse-translations call for special mention. The most widely known is that of Professor Garnett, published by Ginn & Co., of Boston, and now in its seventh edition. It is a faithful translation, in which the author has tried to reproduce the old metre. In this attempt he has achieved a large measure of success, but he has achieved it at the expense of his English. The same merit and the same faults are found in the translation of J. L. C. Hall, also published in America by D. C. Heath & Co. Both these gentlemen are sound scholars, but they are not, nor do they profess to be, poets, and their works are used chiefly, as perhaps they were intended to be, by students of Anglo Saxon, and not by the general reader. But William Morris was undoubtedly a poet, and yet I find his translation of the Beowulf into the old metres and archaic English the most unreadable of them all. He composed his version from a line by line translation made for him by his friend, Mr A. J. Wyatt, of Cambridge, since he was not acquainted with the original. Only an Anglo-Saxon scholar can fully appreciate the patience and skill of the tutor, and the aptness and pertinacity of the pupil displayed in this version of the *Beowulf.* Morris himself regarded it as the one great failure of his poetic career, and his son in-law, Mr

Mackail, tells us in his biography that he was weary of the task before he was half-way through it, and that it was only loyalty to his friend that made him complete it.

The most notable example of a frankly modern translation is that made by Colonel Lumsden, and published by Kegan Paul in 1881. His renderings of the story into ordinary ballad measures are always forceful and vigorous, and, what is more important, they are readable. It is a pity that the book has been so long out of print.

I notice that Messrs. Routledge intend to include a new translation of the poem in one of their *popular* series, the London Library, with *illustrations* on art paper; and so we may presume that the *Beowulf* is coming to its own at last.

Professor James Blyth, M.A., LL.D., F.R.S.E. Obituary notice.

By James Colville, M.A., D.Sc.(Edin.).

[Prepared by request of the Council: read before the Society, 13th February, 1907.]

I esteem it an honour to have been asked by the Royal Philosophical Society of Glasgow to prepare a notice of the life, character, and work of the late Professor James Blyth. The Society does well to cherish his memory, for he was one of its most notable members. Many a time did he delight us in this hall with his singularly clear, earnest, and unaffected scientific exposition, and enrich the *Transactions* with researches that were as novel as they were valuable. I can only regret that I must speak of him not as a physicist but merely as a listener at these lectures; but seeing that I was his oldest friend in Glasgow, I am in a position to emphasise his exceptional gifts as an altogether loveable man. And after all it is uniformly this human note that finds in every one of us the keenest, the kindliest response. Even the best of scientific workers speedily get side-tracked in the rush of new developments. The efficient teacher will leave a greener, sweeter memory than the inefficient, but even he will live only in the casual recollection of some grateful pupil. But character has somewhat in it that endears, and he must be a dull listener who fails to respond to the record of one who used his gifts as ever in his great Taskmaster's eye, who did his day's *darg* with a simple, whole-hearted devotion, and who loved his fellow men withal.

My best thanks are due to the following friends of Professor Blyth for valuable contributions on points wherein my own special knowledge is defective:—Mr Vincent J. Blyth for many fine biographical touches; Messrs H. H. Browning, M.A., B.D., and Wm Calder, English Master, Edinburgh Ladies' College, for notes on the early student days; Professor James Muir for an admirable appreciation of his predecessor as a teacher of science; Dr C. G. Knott, Secretary to the Royal Society of Edinburgh, for a valuable note bearing on the early student days and the later phase of scientific contributions; and lastly, *Emeritus*-Professor M'Kendrick for furnishing, in his usual kindly manner, a sympathetic estimate of Professor Blyth as a scientific worker. From Dr M'Kendrick's eminence in the applications of physics to the elucidation of physiological function this estimate cannot but gratify the many admirers of its subject. Of the foregoing information due acknowledgment is made wherever it is used.

Blyth was one of the country's gifts to the city, a fact that shines through his whole career. And a beautiful and interesting country-side it was that moulded him, man and boy. All through life it held its spell over him, and amid its placid charms he sleeps now with the rude forefathers of the hamlet, its most notable son. Across the broad, pebbled path of the limpid North Esk, a few miles from Montrose, one sees, on its Kincardineshire bank, the wayside hamlet of Marykirk and the white-washed two-storey house in which Blyth was born. If there be any doubt, the windmill in the garden behind, with its quaint vanes, will proclaim the man and his inventive hobbies.

In time he passed through the parish school, then under the late Mr Peace, a gentleman of whom he always spoke with sincere respect and even affection. But his bravest exploit in the way of self-culture was his attendance at Montrose Academy, under Mr Babington Smith, involving as it did a double walk daily of six miles.

Of his boyhood little of course need be told. Upbringing in the country, however, where such a thoughtful and original boy must have found opportunities of making himself, could not but have its influence on the growth of that pronounced individuality, that attitude of homely tastes and sympathies, and that resourcefulness which were such marked features in his character. Long solitary rambles on the hill of Pitbeadlie fostered the habit of observation and independent deduction, while eager participation in the home industries of the village and the farm, developed that general handiness and resource in improvised appliances which stood him in good stead as an experimenter. Individuality and a strong homing instinct came out in one early incident. Located for a short time at Banchory, on Deeside, on account of his health, the boy made for home one day over the hills and down the long bleak moorland slope of the Cairn o' Mount, and so across the Howe o' Mearns to the hamlet by the Esk. The journey called for resolution and self-reliance. An early essay in the art of music shows both a characteristically obliging disposition and the courage of resourcefulness. At a harvest home dance the breakdown of the bass fiddler made a gap in the orchestra. Blyth had been quick enough to observe that three notes sufficed for the gamut of such an accompaniment here, and with bold manipulation of these he successfully filled the blank. His quiet insistance on fact as superior to speculation appears in another instance. At a picnic excursion to an old castle, where he was present, an antiquary lectured ingeniously on what he took to be a Roman weapon found in the recess of the ruined walls. Blyth quietly remarked that it was an old kail gully which he himself had left in the recess after it had done humble service on a similar occasion the previous year. On all these points the boy was father of the man.

Of Marykirk one might well say, on Blyth's behalf, that all through life "his heart untravelled turned to thee." While his parents lived he visited it regularly, and thereafter he peopled the old home with wife and bairns, and ever-welcome friends. I found him one summer making early experiments on electricity as a motive power. Out of two of the obsolete high-wheeled cycles he had put together a primitive car, and, with accumulators on the axle, he was on a fair way of making a start. The windmill in the garden, with its horizontal arms on which large hollow cylindrical vanes were fixed at the extremities, had already demonstrated the fact that work could be got out of the wanton wind in the shape of electric current. But the following notes by his son bring out better than I can the part played by this physical Tusculum of Marykirk. "In 1885 or '86 he began the windmill experiments, in which he kept up an interest till the end. He erected mills, and often rooted them out and re-constructed them, always finding scope for further changes and trials. He used to give popular lectures and demonstrations, sometimes in a barn or schoolroom near by, and these were generally appreciated by the country people. The last one he gave was at Christmas, 1906, for the object of village improvements."

Of his university experiences I never heard him say much. He belonged, however, to a redoubtable group of mathematical students, men of a type that has now dropped out of university life. For various reasons they had not come direct from school, and so were of maturer intellect than the schoolboy student. The tiny calendars of those days do not supply much information, but what there is Dr Knott has hunted up for me. The university facts are these:—"James Blyth graduated B.A. in 1861, just the year the B.A. was abolished. He then attended the Mathematical and Natural Philosophy classes, and distinguished himself in both. In the third (advanced) Mathematics of 1861-2 he was fourth in the honours list, and James Dewar (now Sir J.) was fifth. In the same year he was first in the second, or higher, division of Tait's class, bracketted equal with a Mr Alexander Anderson, of whom I know nothing further. James Dewar came third in this division. In the first, or lower, division of the same year Laird Adams was first; and in subsequent years Laird Adams carried on his medal-taking career into the second and third divisions of the class. The third division afterwards became the advanced class; in those days, however, they listened to the same lectures, but had different home work to do. He took his M.A. in 1871, for which he needed simply to pass in the two additional subjects of Natural Philosophy and Rhetoric." I should add that in Natural Philosophy there is the note in the calendar:—"Prize for the greatest number of written answers to questions upon the lectures, open to all the class, James Dewar." This is the now famous scientist, the Cambridge professor, whose warm friendship Blyth ever retained. Of his professors in Arts I had some personal knowledge of all, even a boyish observation of Aytoun and Pillans, the very last survivors, in Edinburgh at least, of the absolutely unreformed university teaching of the olden times. The bulk of this hard-headed and hard-working type of men had been normal students. I suspected that Blyth had been one himself, but I was not certain till I applied to my own old teacher, Mr Wm Calder, *Emeritus*-English Master, Edinburgh Ladies' College. He supplies this most interesting link between school and university. "Professor Blyth was a student in the Castle Hill Training College during the session 1855-6, when I was one of the masters in the Practising School, as I find from my notes of several lessons which he gave in my room. The Mathematical Master, for whom we all had the greatest admiration, was Mr Charles Hay."

Most probably Blyth sought the preparation of the Training College with a view to the university. In a sense, he and his able compeers were subsequently lost to the main purpose of "My Lords," which was to supply elementary schoolmasters in country districts. The chief merit of that system was to furnish a secondary education to the students in training, which could hardly be said to be attainable otherwise on such economical terms; for admission to the college really meant a money scholarship. The training to teach was of little or no practical value, as far as my experience goes. The benefit to the community that accrued to the church, medicine, journalism, or the civil service, from these normal-university men, was incalculable. But for such of them as had developed expert accomplishments for the teaching of classics or mathematics there were then no openings. The old privileged grammar school looked askance at them as lacking in the traditional scholarship, and so it held on its easy mediæval way. The newer sides in secondary schools—English, science, modern languages—were as yet non-existent except in a few Edinburgh private schools whose proprietors were born enthusiasts, far in advance of their time. In comparison with classics as a disciplinary training, these subjects, when seen through the grammar-school spectacles, were but quackery. To the expert graduate with tastes and training for teaching, as the readiest means of turning his capital to account, there was then little hope of a career, unless he was prepared to slide into casual tutoring, or be the hack of the Edinburgh publishing houses. The former was Blyth's fate. Pillans, Professor of Humanity, gave him the offer of a tutorship at Bath. The story of his experiences here, and his journeyings, was very entertaining, as all natural talk is bound to be, but I need not repeat it. Enough to say that, though the Principal of this boys' boarding-school, a kindly gentleman, urged him to stay with the hope of a partnership, he came back to Scotland. One could not think of Blyth in the comfortable 'gin-horse track of boarding-school respectabilities.

I am unable to fill up the good few years that must have intervened between this and the position in which I first found him. One Morrison, a native of Crieff, who had prospered, but not in it, had endowed a school there, with departments under a classical rector. This gentleman, out of a free residence and boarders from a distance, made a fair living, but the slight local demand and the costs of a good building and ample site left but little of a surplus. Here I found Blyth doing hodman's work, but of course doing it very agreeably for himself and others. I, myself, had just graduated with first-class honours in classics after other teaching experience, two years of the Training College, and the highest University distinction in English. I put these matters, so, purely to emphasise the lessons to be drawn therefrom, in their bearing on the development of modern subjects in Scotch secondary schools. Here, Blyth and I, with a past and a probable future reasonably of considerable value, had to content ourselves with a couple of pounds a week each. After one session I moved, but Blyth remained. The charming district, attached friends, and simple tastes all fitted him well. Meanwhile, in Edinburgh, Dr. Bryce had left the High School and made a new venture outside in Charlotte Square. It was characteristic of Blyth to wait for favours to come to him, so, as Dr Ogilvie of Crieff and Dr Bryce were old friends, he at once found a congenial place in the new school with scope for his special tastes. After a few years here he moved to what is now Watson's College. The endowed Schools Commission had resulted in utilising, for the general behoof, the old-time provision of beautiful souls for their decayed brethren. Under this stimulus the Edinburgh Merchant Company launched their well-known scheme.

In Watson's, Blyth and I again found ourselves colleagues. Another Dr Ogilvie, a brother, was Principal, and it was natural for him to secure his friend Dr Bryce's mathematical master when he had a chance. Here we were both happily fitted with congenial work. As English master I was trying to give, through English classics, such an exact disciplinary training in literature as my friend the late Chief Inspector of Schools, Dr T. A. Stewart, was giving his boys in Latin and Greek. We both had an opportunity of helping on quite new developments. Blyth, for his part, was in a position to create what was the absolutely new technical scientific side to a great and flourishing school. The scheme, however, was started on such economical lines that both of us were allowed to go to Glasgow, Blyth in 1880, myself a few years earlier. Blyth came to exhausting evening work, a crowded gas-laden classroom, students not unfrequently half asleep out of sheer exhaustion after their days' labour. To this must be added the rapid passing through his hands of crowds whom he had neither time nor opportunity to know, for these were the days of small things for Technical Education. He never had a robust physique, and the work must have told upon it. For this he had exchanged his pleasant day work with possibilities of which he could have made anything he liked, the friendship of Professors Guthrie Tait, and Chrystal, and the respect of the Royal Society. To be sure he gained the admiration and lasting gratitude of a long stream of pupils. In our Royal Philosophical Society we were always delighted with what he had to give us. He had the friendship and sympathetic interest in his work of Lord Kelvin. To the University he gave more than he got. He lectured in Queen Margaret as a labour of love long before this institution had what might be called university recognition.

Upon the whole the professional career of Blyth was by no means unlucky. For a working school-master to step into a professor's chair was in itself a rare good fortune. Outside of Glasgow and of Anderson's College, the thing was not then possible in Scotland. In these days it promises to become as rare as ever. At one bound he secured what he dearly loved—a laboratory and a lecture room. It cannot be denied that in both he took far too much out of himself, doing the work of any two of the old type of academic teacher. His friends and admirers were peculiarly gratified when the University of Glasgow crowned his professional career with the degree of LL.D. on the occasion of the celebration of its Ninth Jubilee.

It was in Edinburgh that Blyth really made himself. Of his work here apart from school Dr Knott remarks:—"I am also able to send you a list of all the papers he published in the Royal Society of Edinburgh; and I fancy I must have heard most of them. It was the telephone which brought him forward. I was doing research work in Tait's laboratory when Tait introduced him to me one afternoon as an old medallist, and asked me to help him to put up his wires to demonstrate his new telephone. From that date we continued to be on the friendliest terms, and I saw a good deal of him, sometimes at his own house, sometimes at the University, and also at the Royal Society, until he left Edinburgh for Glasgow. During most of that time I was assistant to Tait, and had frequent occasion to help him (Blyth) in putting up his arrangements. There is no doubt he did a great deal to develop the theory of the microphone receiver; and we were always greatly astonished and amused at the homely bits of apparatus he pressed into his service. His longest paper is the one in the *Transactions* on the Transmission of Sound by loose electrical contact,—well, I should not say longest, but what was considered then as his most important. He never wrote long papers, being content to give the results as briefly as he could. This modesty, I think, led to his papers being overlooked by later workers; and I doubt if he has ever got his due, except from those of us who had the pleasure of hearing him and seeing his demonstrations in the Royal Society Rooms. I have not myself had time to look at his papers, although they are lying near me in this very room, but before I prepare this notice for the Royal Society, I shall refresh my memory by re-reading them all. So far as one can judge from the enclosed list his longest paper is one on the Currents produced by friction, etc. A very admirable article by him is the article Hodograph in the *Encyclopædia Britannica.* Tait had a great regard for that article. Blyth hit upon some neat geometrical proofs. Here also I should have to re-read so as to get at what these proofs were. After he went to Glasgow he had of course very little leisure for research work."

Of this period his son says:—"In the evenings then he was always experimenting with microphones and phonographs, and the large gyroscope which he studied for the ninth edition of the *Encyclopædia Britannica* among several other of his contributions." An edition of Ferguson's Electricity also came from his hands (1882). His enthusiasm for physics found many outlets. The staff of Watson's, full of the zeal of youth, formed a society for the reading of papers. It was here one evening where I first heard Blyth expound in his inimitably natural fashion. With a small model he demonstrated quite successfully the conversion of electric energy into useful work in driving wheels. This was more than thirty years ago. Is there now a more marvellous factor in modern progress? On another occasion I heard his phonograph fitted with a bullock's horn receiver. It was certainly the result of vigorous lung power and language hard to miss—"Loud roars the dreadful thunder, the rain in torrents pours."

The conditions of his life in Edinburgh all made for health and comfort. He had not long before got happily married, a young family was growing up around him, he had a pretty little garden house in the southern suburb of Mayfield, at that time on the skirts of the city. Here his son says:—"He took delight in erecting swings for us, and building sheds and greenhouses; he spent much time in his workshop, but he would often put in a Saturday at digging in the garden. At Christmas and summer we always went to Marykirk for the holidays. Indeed I think there was only one Christmas in his life that he did not go to Marykirk. He was always very contented with his life and work, and I do not think he would have moved to Glasgow if the opening had not been pointed out to him. He never was given to reading the newspapers, and probably would not have noticed the opening." These were all virtues indeed, but they had as usual their defects.

It would have been well for him if he had had some frivolous hobby, say an out-of-door game or pursuit, which, followed consistently and not casually, would have relieved the strain of virtuous concentration. Another drawback was his apparent lack of interest in public events or in general reading under conditions which happened not to be in sympathy with the special bent of his mind and tastes. Blyth never could have been, in the usual paying sense, what Bacon longed to be, "the architect of his fortune." It was during the long and harassing winter when this concentration told adversely. Fortunately he had the enviable long summer holiday. His life then was an all-round healthy one. On this point his son speaks at length:—"Five or six times we were at Berlin for two or three months in summer. My father attended various lectures at the University, and studied German and Mathematics." Helmholz was the bright, particular star there and then. "Once he went to Vienna. He does not seem to have had any great love of travel for its own sake, but he was especially fond of the sea. Long ago he used to go yachting with Mr Young, of Kelly. He was at the three Paris exhibitions, always going as much as possible by sea. Once we sailed as far as Rouen. Frequently he sailed with his brother-in-law or some other captain whom he knew on the Leith and London steamers. He took my brother, when he was ill, across to Norway for the sail, but he did not admire the scenery or enjoy the trip much. His longest voyage was to the Cape about a dozen years ago. He liked a bit of weather, and nothing troubled him except fog." It was his example and persuasion that inspired me to visit Berlin, but I never had the good luck to enjoy such long holidays as he had. As a traveller he went to work in characteristically unsophisticated fashion. He knew as little as possible of hotel or pension, but enjoyed the free-and-easy hired-room-plus-restaurant of the continent. His account of his St. Petersburg trip was original. The deck of a coal steamer laden up at Methil, everything grimy with black dust, made a not very inviting start; but, when under way, diligent scrubbing bettered the situation. The table had little variety to satisfy the fastidious, but the simple conditions formed their own attraction. At Cronstadt, where cargo was discharged, the humble dock-labourers dined, squatting on deck round a pail of water raised from the Neva, and used to *slocken* their only dish, hunks of coarse black bread. Like Barrie's "Tammas Haggart," Blyth was quick to see the humorous side of things, as when he contrasted the profound gratitude of a grandly uniformed and built official with the modest tip which had excited it. In Berlin, again, on one occasion he found himself with other sightseers at the palace of the Crown Prince. But no official doorkeeper was to be found. The party very sensibly conducted themselves round the state apartments. One can imagine the consternation of the official representative of the best-drilled nation under heaven as he returned in time to see them off. Since the enormity of his own offence in leaving his post was as great as theirs, he was only too glad to pocket his tip and keep his "thoom" on the incident. I never cared to tempt him into the region of "potentials" *et hoc genus omne*, but I thoroughly enjoyed these recitals. His talk then had that best of all charms, the personal human note and its revelation of character. There was in it not a trace of bitterness, he never was censorious, he never reflected on others. Latterly, I regret to say, the close application of both of us, coupled with his long vacation out of town, kept us too much apart. What his son says here is very true:—"Since his evening work became so heavy he was not able to keep up intercourse with his friends; but he was much inclined to be sociable, and had a great faculty of making up to strangers in his travels to exchange views with." His hospitality was of the frankest and kindliest. He never spared himself to do a kindness. I remember I had occasion to need his good offices in Edinburgh, and he offered to go through with me on an off Saturday, when he introduced me to the then Lord Provost who happened to be his personal friend. The whole action was in keeping with his truly loveable nature.

So far I have tried to emphasise the personal note in the character of Professor Blyth, mainly because it was with that aspect I was most familiar. As one with the life-long experience alike of student and of teacher, I fully endorse every word of Professor James Muir's appreciation, which he has so ably put together for this notice. I feel, indeed, that it constitutes not the least valuable part of the narrative. We hear much in these days of efficiency. Blyth could play on every string of the instrument. The absolute naturalness of his manner, the spontaneity of his method, the mastery over his resources, the fulness of his knowledge, the untiring interest in the fruit of his efforts, the sympathetic touch on the pulse of the listener, these were conspicuous features of his teaching. They are the only virtues worth having in true teaching. Nature had not endowed him with a powerful voice, and I daresay he never gave a thought to the matter, but it was well suited to his easy colloquial style, while his genuine enthusiasm would have alone sufficed to secure attention. But I shall allow Professor Muir to speak here:—

"In an account of the life and work of the late Professor Blyth, it is perhaps fitting that a word should be said by a representative of a large body of students who passed through his hands, even if it be but a word in acknowledgment before the world of their great debt of gratitude.

"Anyone who cared to study the Calendars of the University of Glasgow, of Anderson's College, and of the Glasgow and West of Scotland Technical College, could form an estimate of the character and extent of Professor Blyth's work. Such a one could not fail to be impressed by the magnitude of the work done. There have been probably very few men indeed who have carried out so much lecturing work. For years, during the winter months, Professor Blyth usually delivered six lectures per day, and very seldom would a day pass in which fewer than five lectures had to be delivered. The mere physical exertion implied in such an amount of lecturing must have been great, and if the character of the work be kept in mind surely there is indicated most exceptional strength of body and of mind.

"It is, however, only one who has sat in the classroom under Professor Blyth who is able to appreciate the quality of his work. Students old and young are unanimous in an enthusiastic appreciation of his qualities as a teacher, and that appreciation becomes fuller and more full with the lapse of time. His devotion to their interests was untiring. He was their true and sympathetic friend, ever ready with a kindly word of encouragement, ever anxious to help the lame dog over the style.

"His teaching possessed the prime quality of impressing the memory. What he taught and illustrated by apt and homely simile could scarcely be forgotten. There is an oft-quoted opinion of Dr Johnson to the effect that lectures cannot do so much good as reading the books from which the lectures are taken. But good books possess what is called style, and so also, surely, do good lectures. Professor Blyth's lectures had a style all their own which made it possible for students to derive pleasure and profit by attendance for successive years on the same course. The lectures were always clear, and yet to his students the great width and depth of Professor Blyth's knowledge was ever apparent. It was a perpetual marvel to them how he managed to carry on from day to day, or, as in the case of evening classes, from one week to the next, so many different courses of instruction. There were apparently no written lectures. Professor Blyth invariably spoke without note or book of any kind, and always advised the budding teachers who came under his sway to do likewise. They were to think well over what they had to lecture about, and then go forward without notes, telling their class and working out on the black-board what they knew, and they would then almost certainly be understood of their students. This ideal of spontaneity, which marks the difference between a dead letter and a living word, was peculiarly exemplified in Professor Blyth's own lecturing.

"In spite of the strenuous life as a teacher which Professor Blyth led, he kept his knowledge thoroughly up-to-date. He found time to read the scientific magazines both home and foreign, and took a keen interest in recent research work. As an exercise for an advanced laboratory student he would ask an experiment described in a recent number of say the *Philosophical Magazine* or of the *Comptes Rendus* to be repeated, and from time to time he tried for himself the more striking of recently published experiments.

"To the foreign student, or the student from the country—the stranger within our gates—Professor Blyth was perhaps exceptionally kind, and many such have happy recollections of Saturday evenings spent under his hospitable roof. But to the hundreds of students who passed year by year through his classes, his kindliness was made manifest in the lecture room, and his influence through them has for long been most widely diffused.

"His students—gone forth from the classroom, and radiated over the country and to far corners of the world, taking now their place in the fore-front of the world's workers, applying their science to industry, or, teachers themselves, handing on the lamp of learning—all bear in the secret structure of their minds the impress of Professor Blyth's teaching, and will cherish through life, with reverence and affection, the memory of their teacher and friend."

I close this notice with Professor M'Kendrick's estimate of those contributions which show how strenuous a worker our departed friend was:—"Professor Blyth's contributions to the literature of physical science were spread over twenty-five years—

from 1877 to 1902. They were mainly of an experimental character, bearing on electrical problems, the action of the telephone and microphone, questions of engineering, and the application of wind power. His arrangements invariably were simple and effective, and they showed much ingenuity and dexterity in manipulation. Perhaps the paper that attracted most attention was one first written in 1885, and more fully developed in 1886 and 1889, "On a new form of Current Weigher for the absolute determination of the strength of an electric current." The Brisbane gold medal of the Royal Society of Edinburgh was awarded to Professor Blyth in 1892 for his work "On the application of Wind Power to the production of electric currents," and the method was applied practically at Marykirk, where he erected a little windmill by which a small dynamo was driven. Professor Blyth believed strongly in the future of this method of harnessing the winds, and he was undoubtedly a pioneer in this department of practical engineering. Like all true teachers Professor Blyth's mind was stimulated by his daily work, and he was constantly devising new methods of observing, recording, and measuring. He was a true man of science, who loved to examine the phenomena of nature for their own sake, and although his name may not be associated with any great discovery, he was one who by insight, patient toil, and mechanical ingenuity did much in his day to explain and illustrate many of the facts of physical science."

It may fairly be said that Professor Blyth died at his post, a few days after the premonitory seizure, towards the close of session 1905-06, within that College to which he had devoted the best part of himself. He had worked through its day of small things, and scarce lived to see the opening out of its wider prospects. As a truly religious soul, faithful to friendship, to duty, and to the All Father, he has passed within the dim portal over which beams the Day Star of eternal hope. To us for whom this is as yet the world of the living and not of the dead, he has left the sweet savour of a well-spent life.

APPENDIX.

LIST OF WRITINGS OF PROFESSOR JAMES BLYTH.

Transactions Royal Society of Arts.

- On the Application of Wind Power to the Production of Electric Currents. Vol. xiii., Part II., p. 173. 1892. (Makdougall-Brisbane Silver Medal.)

Edinburgh and Leith Engineers' Society.

- Note on the Theory of the Reversible Engine. 1873-74.
- The Holz Electrical Machine. 1874-75.
- Flow of a Perfect Fluid through Pipes. 1875-76.
- Machines for Converting Mechanical Work into Electricity. 1876-77.

British Association.

- On a New form of Galvanometer, p. 939. 1885.
- On a New form of Current Weigher for the absolute determination of the strength of an Electric Current, p. 521. 1886.
- On a New form of Current Weigher, p. 511. 1889.

Philosophical Society of Glasgow.

- The Wire Telephone. 10th February, 1881.
- On an Endless Solenoid Galvanometer and Volt-meter. Vol. xv., pp. 187, 372, 386. 1883-84.
- On a New form of Galvanometer. Vol. xvii., p. 204. 1885-86.
- The Application of Wind Power in the Generation and Storage of Electricity. Vol. xix., p. 363. 1887-88.
- On a Combined Windmill and Dynamo. Vol. xxii., p. 315. 1890-91.
- An Experiment on Self-Induction. Vol. xxii., p. 315. 1890-91.
- Some Experiments with Coherers. Vol. xxxi., p. 196. 1899-1900.
- An additional Experiment with the Electric Sonometer. Vol. xxxiii., p. 267. 1901-02.

Encyclopædia Britannica Articles.

- Graduation (of Instruments).
- Hodograph.
- Gyroscope.
- Several minor articles.

Transactions Royal Society of Edinburgh.

An account of some Experiments on the Telephone and Microphone. Vol. xxviii., Part II., p. 557. 1877-78.

On the Transmission of Sound by Loose Electrical Contact. Vol. xxix., Part I., p. 281. 1878-79.

Proceedings Royal Society of Edinburgh.

Substitution of Copper Plate, Wood, India-paper, etc., for the Iron Disc of a Telephone. Vol. ix., No. 101, p. 535. 1877-78.

Experiments with the Telephone. Vol. ix., No. 101, p. 553. 1877-78.

An account of some Experiments with the Telephone and Microphone. Vol. ix., No. 101, p. 711. 1877-78.

Notes on some Experiments with the Telephone. Vol. x., p. 45. 1879-80.

On Currents produced by Friction between Conducting Substances, and on a New form of Telephone Receiver. Vol. x., p. 548. 1879-80.

Note on the Wire Telephone as a Transmitter. Vol. x., p. 730. 1879-80.

Note on an Electric Sonometer. Vol. xi., No. 108, p. 28. 1883-84.

On a Simple form of Selenium Cell. Vol. xi., No. 108, p. 119. 1883-84.

On the Cause of Sounds produced in the Microphone Receiver. Vol. xi., No. 108, p. 206. 1883-84.

On the Action of the Microphone. Vol. xi., No. 108, p. 622. 1883-84.

Note on a New form of Galvanometer. Vol. xii., No. 117, p. 594. 1883-84.

The absolute determination of the Strength of a Current by means of the Balance. Vol. xiii., No. 121, p. 650. 1885-86.

New Edition of Ferguson's Electricity. 1882.

Disposal of the Dead. By Professor HUGH GALT, B.Sc.(Pub. Health), M.B., F.F.P.S.(Glas.), D.P.H.(Camb.)

[Read before the Sanitary and Social Economy Section, 6th March, 1907.]

ABSTRACT.

MORE than two decades have elapsed since this subject was considered in a paper submitted to the Society by Dr Ebenezer Duncan, and it seems a fitting opportunity to consider once more the position from various points of view.

It is clear that cremation has not made the progress which was so confidently expected by its advocates. At the present time only a small fraction of one per cent. of the dead in this country are thus dealt with. The increase in the practice of cremation is infinitesimal when considered with reference to the total number of deaths, while in the case of one or two years the figures show an actual retrogression. It is clearly evident that for various reasons cremation is not likely, in the near future, to be anything more than an isolated exception to the customary method of disposal of the dead by earth burial. It becomes, therefore, important for all authorities on Public Health, to consider in what manner this earth burial can be carried out with due regard to the claims of the living. In this connection it is interesting to note that of those authorities in Public Health matters who have died in recent years few, if any, have left specific instructions that their remains were to be cremated. While on all hands cremation in the abstract is admitted to be admirable, when it comes to the concrete and personal application it is a different matter.

The evils of churchyard burial are so well recognised that, except in very isolated and sparsely populated country districts, this method has by common consent been given up entirely, and cemeteries have been set apart for this purpose. Owing to the lack of proper control over certain of these cemeteries, evils have occurred, chiefly from such causes as improper soil, undue proximity of graves to each other, insufficient depth of graves, too many corpses interrêd in each lair, cemeteries used for interment of bodies long after the ground should have been closed, etc. It

will be evident that all the evils mentioned are easily remediable, and the remedies are almost self-evident.

It must be remembered that the decomposition following upon proper earth burial differs entirely from the offensive putrefaction which occurs above ground. It is well known, and has been abundantly demonstrated recently by Dr Vivian Poore, that properly selected earth has enormous powers of deodorisation and resolution into simple gases and water of animal remains. Popular ideas as to putrefaction of dead bodies under ground are as erroneous as the idea that the flesh is consumed by worms; worms exist only in the upper few feet of the soil, and are never found, unless accidently, deeper than six feet.

The emanations from even strictly conducted cemeteries have been supposed to be harmful to the living. Apart from "moral and intellectual" damage is there any confirmation of this? No doubt illnesses of various kinds have been put down in a loose way to emanations from soil covering dead bodies, in much the same way that diphtheria is frequently put down to defects in drainage; but, as a matter of fact, not a single case of a specific disease has ever been shown to be due to infection by the gaseous emanations from the soil of churchyards and cemeteries, even in their present often unsatisfactory state. It is the *living* who are suffering from infectious disease who are the source of our gravest dangers. The organisms of disease die out very quickly in the dead body.

Earth burial has also the very great advantage that detection of crime in the form of violence and poisoning is possible for very long periods after death, while this evidence is entirely and immediately destroyed in the event of the body being cremated. The advocates of cremation say that adoption of the latter would tend actually to diminish crime, from (1) the safeguards which attend the preliminary stages in cremation, and (2) the present large number of interments which take place annually without proper medical certification. The latter part of the argument is a very strong plea indeed for the amendment of existing methods of death certification, not for cremation. The preliminary precautions in cases of cremation are more apparent than real. The second medical man, of course, seldom or never interferes, in fact cannot interfere, with the diagnosis of the first, and the number of *post-mortem* examinations performed on bodies before cremation is infinitesimal. In Glasgow there has never been a *post-mortem* examination made by the doctor appointed for the purpose. To a large extent crime increases with increase of facilities for its commission, and such facilities are given by cremation, as in very many cases suspicion of crime only arises when some time has elapsed after death and other circumstances occur which tend to arouse suspicion. Many cases of exhumation of bodies on suspicion of poisoning or violence, where medical certificates of death have been granted in all innocence, can be easily cited. On the average, about ten exhumations per annum are performed in this country in this connection, with resultant proofs of crime in over 20 per cent. of these.

Cremation would totally destroy all subsequent evidence of violence, and of such poisons as:—Oxalic Acid, Cyanides, Phosphorus, Morphia, Corrosive Sublimate, Arsenic, Chloral Hydrate, Chloroform, Strychnine, and almost all poisons of vegetable origin.

As the result of my inquiry into the whole question I have come to the following conclusions:—

1. With suitable modifications our present system of earth burial can be conducted without danger to the community.

2. While there are no actual religious, social, or sanitary objections to cremation, the great preponderance of public sentiment is against this method.

3. The general adoption of cremation would lead to an increase in criminal deaths from violence and poison.

RULES GOVERNING THE COMPETITION FOR THE GRAHAM MEDAL.

1. The competition for the Graham Medal shall be under the authority and control of the Council of the Royal Philosophical Society of Glasgow, whose decision on all points connected therewith shall be final.

2. Each candidate shall forward to the Secretary of the Royal Philosophical Society of Glasgow, 207 Bath Street, Glasgow, on or before 14th March of the year in which the competition is held, a paper giving an account of an unpublished original research conducted by himself in any branch of chemical science.

3. The medal shall be awarded to the candidate whose research, in the opinion of the Council, or of the person or persons whom they may appoint to adjudicate in the matter, is of the highest merit, and most likely to aid in the advancement of chemical science.

4. The successful candidate shall read the paper, on account of which the medal is awarded, to the Royal Philosopical Society of Glasgow. The paper shall thereafter be published in the *Proceedings* of the Society, and its publication elsewhere shall not take place without the permission of the Council.

5. No award shall be made if, in the opinion of the Council, no candidate has contributed a paper of sufficient merit.

MINUTES OF SESSION.

1906-1907.

7th November, 1906.

The First Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 7th November, 1906, at 8 o'clock. In the absence of the President Mr John Mann, Junr., Vice-President, occupied the chair.

1. The Hon. Secretary intimated that no Minute would be read, as that for the previous Meeting was published in the last issue of the *Proceedings*, and had been read and approved at the close of the Meeting itself.

2. On the motion of the Hon. Secretary the Standing Orders were suspended that he might draw attention to the deaths since last Meeting of Dr Blackie, Dr James Finlayson, and Professor James Blyth. It was unanimously agreed to record the deep regret of the Society at the loss of these distinguished Members, and it was remitted to the Council to take what further steps seemed proper.

3. Mr Wm Gavin Purdie, who was elected at last Meeting, was duly admitted to Membership.

4. Mr Mann here vacated the chair, and it was then taken by Dr Duncan, Hon. Vice-President.

5. Dr John Brownlee, Physician Superintendent, Fever Hospital, Belvidere, read a paper on "Statistical Studies in Immunity: The Incubation Period and the Crisis," which was a communication from the Sanitary and Social Economy Section.

A discussion followed in which part was taken by Dr Duncan and Dr Chalmers.

The thanks of the Meeting were accorded to Dr Brownlee on the motion of the Chairman.

6. Dr James W. Allan, late Physician, Royal Infirmary, read a

paper entitled, "On the use of Stimulants, Narcotics, and Intoxicants, among Uncivilized Peoples."

A vote of thanks was passed to Dr Allan on the motion of the Chairman.

7. The Hon. Secretary announced that the following gentlemen had been duly elected to Membership of the Society:—

1. Mr JOHN M. FALCONER, Margham, Broomhill Road, Partick. Recommended by Mr J. V. Stevenson, Mr W. Maclay, and Dr George Neilson.
2. Mr ANDREW HEWAT, J.P., 9 Berkeley Terrace. Recommended by Dr Freeland Fergus, Dr Oswald Fergus, and Professor Peter Bennett.
3. Mr THOMAS D. ROBB, M.A., Auchinsale, Potterhill, Paisley. Recommended by Dr George Neilson, Mr J. T. T. Brown, and Mr John Clark.
4. Mr JOHN STOBO, M.A., Teacher, 142 St. George's Road. Recommended by Mr John Robertson, Professor Magnus Maclean, and Professor Peter Bennett.

REPORT OF COUNCIL FOR SESSION 1905-1906.

I. *Meetings of the Society.*—Session 1905-06 was begun on 1st November, 1905. The opening lecture was delivered by Mr. Henry A. Mavor, on "A Solar Eclipse Expedition." A special lecture, under the auspices of the Science Lectures Trust, was delivered by Sir William Ramsay, K.C.B.; subject: "Some Facts and Theories connected with the Inactive Gases of the Atmosphere."

Twelve ordinary meetings were held during the session, and sixteen communications made, of which eight are printed in vol. XXXVII. of the *Proceedings*. The attendance was considerably above the average of former years, and the keen interest taken by the members in the business of the meetings was shown by the animated discussions which followed the reading of the papers. To mention one instance: the paper on "The Social Reformation of Criminals" excited so much interest that the discussion on it was continued, and occupied the whole of another evening.

II. *Purchase of Buildings.*—Two extraordinary meetings were held, and at these an agreement with the Institution of Engineers and Shipbuilders in Scotland for the purchase of their interest in the buildings, 207 Bath Street, provisionally entered into by the Council on behalf of the Society, was adopted and confirmed, and powers given to the Council to borrow to the extent of £4,000. Under these powers £3,250 was borrowed at 3½ per cent. secured by a bond on the buildings. The purchase was carried out at Martinmas, 1905

III. *The Sections of the Society.* — The Sections have been very active during the past year. Papers from all seven appear in the *Proceedings*, and, with a few exceptions, those read at the meetings of the Society were communications from the Sections. The Architectural and the Historical and

Philological Sections, as usual, issued full syllabuses of work for their meetings about the beginning of the session. The other Sections arranged the business for their meetings as opportunity offered, but their work was none the less efficient. The Biological Section, as stated in last report, has been reorganised, and is now in a flourishing state. Several meetings were held during the session, and two of the papers read are published in the *Proceedings*.

IV. *The Proceedings.*—It is not expected that Volume XXXVII. of the *Proceedings* will be ready for distribution to Members before the end of November. It contains fourteen papers, in addition to Minutes of Meeting, list of periodicals and exchanges, and the roll of Members. Of these papers eight were read at Meetings of the Society, and six at Meetings of the Sections. The subjects dealt with are very varied in character. Some give the results of painstaking and extended research; others record valuable additions to science, derived from experimental investigation, and others, again, throw new light on pressing social and economic problems.

V. *Representatives of the Society.*—Mr. Walter W. Blackie was reappointed representative on the Board of Governors of the Glasgow and West of Scotland Technical College. Mr. John Robertson continues to represent the Society on the General Committee of the Marine Biological Association of the West of Scotland. Mr. Gilbert Thomson was appointed representative at the Congress of the Royal Sanitary Institute held at Bristol. Mr. Henry A. Mavor was appointed representative for the Meeting of the British Association held at York. Professor Peter Bennett attended, as delegate of the Society, the Franklin Celebrations held at Philadelphia. An address suitable for the occasion was presented by him to the American Philosophical Society.

VI. *Vacancy in Council.*—Mr. John A. Todd was appointed a Member of Council in room of the late Lord Inverclyde.

VII. *Telephones.*—For the convenience of Members public call telephones, both Corporation and National, have been installed in the rooms.

VIII. *Refreshments at Meetings of the Society.*—Arrangements were made in February last for serving tea and coffee to Members after Meetings of the Society. The result has been entirely satisfactory.

IX. *The Library.*—The statistics of the Library, for the year, are given in the Report of the Library Committee, which follows. It is desired to direct attention to certain recommendations made by the Committee.

X. *Membership.*—During the session 62 members were elected, 33 have resigned, and 20 have died. The increase in membership is therefore 9.

The death took place during the session of one honorary member, Professor S. P. Langley, of Washington; also of the following ordinary members:—Lord Inverclyde, Dr. W. G. Blackie, Professor J. Blyth, Messrs. J. M. Blair, R. A. Bryden, John Clark (9 Wilton Crescent), R. A. Cruikshank, John Dansken, F. G. Dougall, Jas. Johnston, Jas. Leipper, Mudie M'Ara, J. K. M'Donald, Francis M'Kean, G. J. Miller, C. W. B. Pearce, Jas. Provan, Robt. Scott, R. W. Thom, and T. M. Welsh; of these, three were life members.

Of the new members admitted, six qualified as life members. The total number of life members at the end of the session is 292.

The roll now includes 16 honorary members, 19 corresponding members and 954 ordinary members (annual and life), a total of 989.

XI. *Finance.*—The Treasurer's statement for 1905-1906 shows a surplus of ordinary revenue over ordinary expenditure of £60 8s. 3d. compared with £93 5s. 11d. in the previous session; adding £130 15s. 6d., the excess of extraordinary revenue over extraordinary expenditure, the surplus is increased to £191 3s. 9d., against £75 13s. 11d. in the previous session.

The Balance Sheet shows that the Capital of the Society at 30th September, 1906, amounts to £4,988 3s. 7d., taking the Heritable Property at cost, but without placing any value upon the Library.

Separate statements show the position of the Funds which the Society holds in Trust, viz.:—The "Graham Medal and Lecture Fund" and the "Science Lectures Associates Fund," the balances of revenue at 30th September, 1906, being £101 18s. 8d. and £27 2s. 10d. respectively.

FREELAND FERGUS, *Hon. Secretary*
PETER BENNETT, *Secretary.*

REPORT OF THE LIBRARY COMMITTEE.

The Library Committee has to report that, during the past Session Members have not made use of the Library so largely as in the previous year. 1060 books were issued to 681 Members. The periodicals on the tables were freely taken advantage of, and the consultations of books continued to be numerous.

The periodicals received at the Library numbered 106, of which 68 were bought, and 38 were sent in exchange for the *Proceedings.*

There were added to the Library by purchase 99 volumes, and 4 parts of works, and 44 volumes, 6 parts of works and 19 pamphlets were presented.

The *Proceedings* of the Society were forwarded to 192 Societies and Public bodies, and 278 volumes and 193 parts of works were received in exchange.

During the year there were, altogether, added to the Library 421 volumes, 213 parts of works and 19 pamphlets. The number of complete volumes, exclusive of pamphlets, now reaches an estimated total of 15,814.

Since last report 270 volumes have been bound.

The Surveyors' Institution, London, the Institution of Accountants and Actuaries in Glasgow, and the Ohio State University, Columbia, U.S.A., were added to the list of exchanges.

There will be found, in Volume XXXVII. of the *Proceedings*, a list of the books purchased and of those presented, along with the names of the donors, the titles of all the periodicals received by the Society, and the names of the Societies throughout the world with which exchanges are effected.

The Committee desire to point out:—

(1) That Members wishing to recommend books for addition to the Library should do so in the book or the purpose kept in the Library;

(2) That the maps for the Geological Survey of Scotland, on the scale of one inch to the mile, and those on the scale of six inches to the mile, as well as the Illustrated Abridgment of Specifications of Patents are sent to the Library for the use of the Members and of the public;

(3) That copies of the Catalogue of the books recently issued can be procured from the Librarian by those who have not yet applied for them ; and

(4) That all new books, as received, are entered in the catalogue that lies on the Library table, besides being printed at intervals in the billets of the Meetings, and in the volume of *Proceedings*.

JOHN ROBERTSON, Hon. Librarian,
Convener.

21st November, 1906.

The Annual Business Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 21st November, 1906, at 8 o'clock. The President, Dr David Murray, occupied the Chair.

1. The Minute of previous Meeting, of date 7th November, 1906, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting, were duly admitted.

3. The Annual Report by the Council, the Hon. Treasurer's Abstracts of Accounts, signed by the Auditors, and the Report on the Library (all of which were printed in the second billet), were held as read, and were adopted on the motion of the Chairman. Votes of thanks were accorded to the Auditors Mr John F. Campbell and Mr James Neilson, and to the donors of books, etc.

4. Professor P. Hume Brown, M.A., LL.D., read a paper entitled—"The Youth of James Anthony Froude," being a communication from the Historical and Philological Section.

Dr Neilson and the Chairman made appreciative remarks on the paper, and a vote of thanks was passed to Professor Hume Brown.

5. Mr Charles R. Gibson gave a demonstration of vibrating plates and bars, being a communication from the Mathematical and Physical Section. In a discussion which followed Professor Jamieson, Mr H. A. Mavor, Mr Mollison, Mr Machell, and the Chairman took part.

ABSTRACT OF REVENUE AND

AND COMPARISON WITH

ORDINARY REVENUE.		1905-1906.	*1904-1905.*
		£ s. d.	£ s. d.
SUBSCRIPTIONS of 651 Members,	£683 11 0		
Arrears,	7 7 0	690 18 0	*673 1 0*
SUBSCRIPTIONS OF ASSOCIATES OF SECTIONS—			
ARCHITECTURAL,	£22 0 0		
ECONOMIC SCIENCE,	4 15 0		
GEOGRAPHICAL AND ETHNOLOGICAL,	0 5 0		
HISTORICAL AND PHILOLOGICAL,	1 10 0	28 10 0	*24 15 0*
		£719 8 0	*697 16 0*
EXCESS OF ORDINARY REVENUE over Ordinary Expenditure brought down,		60 8 3	*93 5 11*
EXTRAORDINARY REVENUE.			
SUBSCRIPTIONS—			
62 Entry Moneys, at 21s.,		65 2 0	*25 4 0*
Life Subscriptions at £12 12s.— 6 New Members,		75 12 0	*136 10 0*
PROFIT ON REALISATION OF INVESTMENT— Caledonian Railway £110 3 °/。 Preferred Converted Stock,		37 15 3	
		£238 17 6	*254 19 11*

EXPENDITURE—SESSION 1905-1906.

SESSION 1904-1905.

ORDINARY EXPENDITURE.			1905-1906.	*1904-1905.*
			£ s. d.	*£ s. d.*
Administration Expenses—				
Remuneration to Secretary, - - - -		£100 0 0		
Allowance for Treasurer's Clerks, - -		15 0 0		
Commission to Collectors, - - - -		7 17 6		
Telephone Rent, - - - - - -		5 5 0		
Stationery, - - - - - - - -		4 0 9		
Fire Insurance on Library, - - -		6 10 0		
Postages and Sundry Charges,	£26 14 0			
Less Papers sold, - -	0 11 2			
		26 2 10		
Expenses of Rooms—			164 16 1	*158 5 0*
Upkeep and Service for year, - - - -		£299 5 11		
Interest on Bond, £101 4s. 4d.—*Less* on Investments, £18 16s. 6d., - - -		82 7 10		
		£381 13 9		
Deduct—Rents from Institution of Engineers and other Societies, - -		£291 8 3		
Library—			90 5 6	*102 3 6*
New Books and Periodicals, British and Foreign, - - - - - - - - -			179 19 6	*83 3 7*
Printing, etc.—				
Printing and Postage of *Proceedings*, Circulars, etc., -			203 16 3	*246 18 2*
Subscriptions to Societies, &c.—			8 8 0	*1 1 0*
Expenses of Sections per Secretaries—				
Architectural, - - - - - - - -		£7 8 0		
Economic Science, - - - - - -		3 0 1		
Historical and Philological, - - -		1 2 4		
Sanitary and Social Economy, - - -		0 4 0	11 14 5	*12 18 10*
			£658 19 9	*604 10 1*
Excess of Ordinary Revenue over Ordinary Expenditure carried down, - - - - - - -			60 8 3	*93 5 11*
			£719 8 0	*697 16 0*

EXTRAORDINARY EXPENDITURE.	1905-1906.	*1904-1905.*
Legal Expenses, in connection with Purchase of Property, Lease, Bond, &c., - - - - - - - - -	39 14 11	*0 0 0*
Expenses of Rooms—		
Refreshment Urns, &c., - - - - - - -	7 18 10	*0 0 0*
Library Catalogue, - - - - - - - - -	0 0 0	*179 6 0*
Surplus carried to Capital Account, - - -	191 3 9	*75 13 11*
	£238 17 6	*254 19 11*

Royal Philosophical Society of Glasgow.

BALANCE SHEET, AS AT 30TH SEPTEMBER, 1906.

LIABILITIES.		
BOND—		
Over Buildings at $3\frac{1}{2}$ %,		£3250 0 0
ACCRUED CHARGES—		
Interest, Rates, &c., *less* Rent accrued,		20 17 0
CAPITAL—		
At beginning of Session,	£4796 19 10	
Add Surplus per Revenue Account,	191 3 9	
		£4988 3 7
		£8259 0 7

ASSETS.		
BUILDINGS—		
207 Bath Street—Buildings and Furnishings, Society's half per last Account,	£3933 7 4	
Price paid for share of Institution of Engineers and Shipbuilders,	4000 0 0	
		£7933 7 4
LIBRARY—		
Not valued,		0 0 0
CASH—		
Clydesdale Bank—Deposit Receipt,	£300 0 0	
In Treasurer's hands,	25 13 3	
		325 13 3
		£8259 0 7

GLASGOW, *5th November, 1906.*—We, the Auditors appointed by the Society to examine the Honorary Treasurer's Accounts for the session 1905-06, have examined the same, and have found them correct, the Balance due by the Treasurer being Twenty-Five Pounds Thirteen Shillings and Three Pence.

JNO. F. CAMPBELL.
JAMES NEILSON.

JNO. MANN, C.A., *Honorary Treasurer.*

GRAHAM MEDAL AND LECTURE FUND.

ABSTRACT OF TREASURER'S ACCOUNT, Session 1905-1906.

Dr.

Capital at 30th September, 1905—		
£250 Glasgow and South-Western Railway Co. 4 Per Cent. Preference Stock in name of the Philosophical Society, in Trust,	£250 0 0	
Value of Die at H.M. Mint,	18 18 0	
		£268 18 0
Accumulated Revenue at 30th September, 1905—		
Cash in Bank,		90 5 10
Revenue—		
Dividend, March, 1906, less Tax	£4 15 0	
,, Sept., ,, ,,	4 15 0	
Interest from Bank,	2 2 10	
		11 12 10
		£370 16 8

Cr.

Capital at 30th September, 1906—		
Investment, *per contra*, (present value, £280),	£250 0 0	
Die,	18 18 0	
		£268 18 0
Balance, being Revenue—		
In Bank, on Deposit Receipt,		101 18 8
		£370 16 8

Glasgow, *5th November, 1906.*—Examined and found correct.

JNO. F. CAMPBELL.
JAMES NEILSON.

JNO. MANN, C.A., *Honorary Treasurer.*

THE SCIENCE LECTURES ASSOCIATION FUND.

ABSTRACT OF TREASURER'S ACCOUNT—Session 1905-1906.

Dr.

Capital at 30th September, 1905—		
£200 Caledonian Railway Company 4 Per Cent. Preference Stock, No. 1, in name of the Philosophical Society, in Trust, cost, - - - - -	£244 4 8	
On Deposit Receipt, - - - - -	8 5 4	
		£252 10 0
Accumulated Revenue, 30th September, 1905—		
Cash in Bank, - - - - - - - -		61 1 3
Revenue for Year 1905-1906—		
Dividend, April 1906, less Tax, - -	£3 16 0	
„ Oct., „ „ - -	3 16 0	
Interest from Bank, - - - - -	1 12 6	
		9 4 6
		£322 15 9

Cr.

Capital at 30th September, 1906—		
Investment, *per contra*, (present value, £228), - - - - -	£244 4 8	
In Bank, on Deposit Receipt, - -	8 5 4	
		£252 10 0
Expenditure—		
Sir William Ramsay, fee for Lecture on "Some Facts and Theories connected with Inactive Gases in the Atmosphere," - - - -	£42 0 0	
Outlays in connection with Lecture, -	1 2 11	
		43 2 11
Balance of Revenue at 30th September, 1906—		
In Bank, on Deposit Receipt, - - - - - -		27 2 10
		£322 15 9

Glasgow, *5th November, 1906.*—Examined and found correct.

JNO. F. CAMPBELL.
JAMES NEILSON.

JNO. MANN, C.A., *Honorary Treasurer.*

The thanks of the Meeting were accorded to Mr Gibson on the motion of the Chairman.

6. The Hon. Secretary announced that the following gentlemen had been duly elected to Membership of the Society:—

1. Mr R. A. BERRY, Professor of Chemistry, West of Scotland Agricultural College, 6 Blythswood Square. Recommended by Principal R. Patrick Wright, Dr R. M. Buchanan, and Professor Peter Bennett.
2. Mr ALEXANDER GARDNER, Architect, 134 Bath Street. Recommended by Mr Thos S. Fraser, Mr Wm Fraser, and Dr Freeland Fergus.
3. Mr THOS JONES, M.A., Anwylfan, East Kilbride. Recommended by Mr John A Todd, Mr H. A. Mavor, and Mr John Mann, Jun.
4. Dr WM D. MACFARLANE, 17 Woodside Crescent. Recommended by Dr Ebenezer Duncan, Dr Wm Snodgrass, and Mr John Robertson.
5. Dr WM D. MACFARLANE, Jun., 17 Woodside Crescent. Recommended by Dr Wm Snodgrass, Mr John Robertson, and Dr Freeland Fergus.
6. Mr WILLIAM W. RUSSELL, M.A., 235 West Princes Street. Recommended by Mr John Robertson, Professor Magnus Maclean, and Dr Freeland Fergus.
7. Mr WALTER A. SCOBLE, B.Sc., Glenturret, Paisley Road, Renfrew. Recommended by Dr Freeland Fergus, Dr Oswald Fergus, and Principal Angus M'Lean.

5th December, 1906.

The Third Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 5th December, 1906, at 8 o'clock. In the absence of the President Professor Andrew Gray, Vice-President, occupied the chair.

1. The Minute of previous Meeting, of date 21st November, 1906, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting, were duly admitted.

3. Professor Andrew Gray, LL.D., F.R.S., read a paper on "The Limiting Speed of Vehicles moving on Curves, and the Effect of the Gyrostatic action of the wheels on Stability."

A discussion followed in which Mr T. Lindsay Galloway and Professor Jamieson took part, and on the motion of the latter a vote of thanks was passed to Professor Gray.

4. Mr Peter Macnair, Curator of the Natural History Collections in the Kelvingrove Museum, read a paper, illustrated by specimens and lantern slides on "The History and Development of the Natural History Collections in the Glasgow Museums."

Mr James Paton, Dr James Knight and Professor Gregory took part in a discussion which followed, and Mr Macnair was accorded the thanks of the Meeting on the motion of the Chairman.

5. The Chairman read a letter containing an invitation from the President and Council of the Local Branch of the British Astronomical Association to the Members of the Society to attend a lecture on Astronomy, in the Glasgow Technical College, on the 20th curt., at 8 p.m.

6. The Chairman announced that the following gentlemen had been duly elected to Membership of the Society:—

1. Mr W. MACNEILE DIXON, M.A., Litt.D., Professor of English Language and Literature in the University of Glasgow, 2 South Park Terrace, Hillhead. Recommended by Mr John Clark, Professor Dudley J. Medley, and Dr George Neilson.
2. Mr ALEXANDER MACKIE, Bank of Scotland, Glasgow. Recommended by Dr David Murray, Mr Jno. Mann, and Mr Ludovic M'L. Mann.
3. Mr J. CAMPBELL MURRAY, 216 West George Street. Recommended by Sir John Stirling-Maxwell, Bart., Mr John Mann, Jun., and Mr William Fraser.
4. Mr GEORGE B. SAWERS, Hydepark Locomotive Works, Glasgow. Recommended by Professor Archibald Barr, Mr Hugh Reid, and Mr Andrew T. Reid.
5. Mr WILLIAM TANNOCK, Woodend, Tarbolton. Recommended by Professor Magnus Maclean, Professor James Muir, and Professor Peter Bennett.
6. Mr ROBERT S. WARDLAW, 25 High Street, Tillicoultry. Recommended by Professor James Muir, Professor Magnus Maclean, and Professor Peter Bennett.

19th December, 1906.

The Fourth Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 19th December, 1906, at 8 o'clock. The President, Dr David Murray, occupied the chair.

1. The Minute of previous Meeting, of date 5th December, 1906, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. Mr A. F. Whyte, M.A., opened a discussion on the "Free Feeding of School Children," being a communication from the Economic Science Section.

Among the speakers who followed Mr Whyte were Mr Beckett, Rev. Mr Finlay, Mr M'Cracken, Mr James Stewart, Dr Chalmers, Rev. Erskine Hill, Mr Jones, and Dr Murray.

On the motion of the President a vote of thanks was passed to Mr Whyte and those who contributed to the discussion.

4. The Chairman announced that the following gentlemen had been duly elected to Membership of the Society:—

1. Mr DUNCAN MACGILLIVRAY, M.A., 37 Leven Street, Pollokshields. Recommended by Dr George Neilson, Mr John Clark, and Mr J. T. T. Brown.
2. Mr JAMES TAYLOR, Accountant, 143 West Regent Street. Recommended by Professor John Glaister, Dr Freeland Fergus, and Dr Oswald Fergus.

16th January, 1907.

The Fifth Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 16th January, 1907, at 8 o'clock. The President, Dr David Murray, occupied the chair.

1. The Minute of previous Meeting, of date 19th December, 1906, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The Standing Orders having been suspended that attention might be drawn to recent deaths of prominent Members, the President referred to the death of Principal Story. He said that before commencing the business they could not do otherwise than shortly refer to the death of the eminent man whose remains were laid to rest in the churchyard at Rosneath that afternoon. Dr

Story was not an active member of the Society, but when he was promoted to the high office which he held he expressed a desire to become a member, because he thought it his duty, holding the office of Principal of the University, to be a member of a society whose object was the promotion of learning and science. The Principal was a man with many engagements and many duties, and unfortunately he could not take part in the proceedings of the Society, but he always had its welfare at heart. He (Dr Murray) did not think that was the time or place to attempt any appreciation of the life or character of Principal Story, but he thought all would agree with him that in his death Scotland had lost a notable son, and Glasgow a distinguished citizen.

3. The Honorary Secretary intimated that since last Meeting the Society had lost one of its most highly esteemed office-bearers, Mr John Robertson, and moved the following resolution which was unanimously adopted :—

> "THE ROYAL PHILOSOPHICAL SOCIETY OF GLASGOW has heard with deep regret of the death of Mr John Robertson, who for a period of more than a quarter of a century discharged the arduous duties of Honorary Librarian with conspicuous ability and fidelity. His wide knowledge of science, and his extensive acquaintance with books relating thereto, specially fitted him to discharge the duties of his office ; and the success of his work is to be found in the large and important collection of books which are in the possession of the Society. The Meeting directed the Secretaries to record in the Minute Book of the Society their sincere regret at the death of so learned and useful a Member ; and further instructed them to convey to the relatives of the late Mr Robertson an expression of their deep and respectful sympathy."

4. The New Members elected at the previous Meeting were duly admitted.

5. Dr James Macphail delivered a lecture, profusely illustrated by lime-light views, on "The Santals of Bengal," being a communication from the Geographical Section.

The President made appreciative remarks on the lecture, and on his motion the thanks of the Meeting were accorded to Dr Macphail.

6. The Hon. Secretary announced that the following gentlemen had been elected to Membership of the Society:—

1. Mr **John A. Balfour**, F.R.Hist.S., Kelvindare, Kelvinside, Glasgow. Recommended by Mr J. J. Spencer, Mr Charles L. Spencer, and Professor Peter Bennett.
2. Mr **William M. Bergius**, 8 Marlborough Terrace, Kelvinside. Recommended by Mr J. J. Spencer, Mr Charles L. Spencer, and Professor Peter Bennett.

30th January, 1907.

The Sixth Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 30th January, 1907, at 8 o'clock. In the absence of the Pesident the Senior Vice-President, Professor Andrew Gray, occupied the chair.

1. The Minute of previous Meeting, of date 16th January, 1907, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. Professor W. Macneile Dixon, of Glasgow University, delivered a lecture on "Inspiration in Poetry," being a communication from the Historical and Philological Section.

Appreciative remarks were made by Mr. John Edwards, Professor Archibald Barr, and Professor Andrew Gray, and a vote of thanks was accorded to Professor Dixon on the motion of Mr Amours, the President of the Historical and Philological Section.

4. The Hon. Secretary announced that the following gentlemen had been elected to Membership of the Society:—

1. Mr **Dugald Bannatyne**, C.A., 191 West George Street. Recommended by Dr Freeland Fergus, Dr Oswald Fergus, and Mr John Mann, Jun.
2. Mr **James R. Douglas**, 43 Queen Mary Avenue. Recommended by Mr Robert Brown, Dr Freeland Fergus, and Professor Peter Bennett.
3. Mr **F. C. Gardiner**, 24 St. Vincent Place. Recommended by Mr J. J. Spencer, Mr John Mann, Jun., and Mr Charles L. Spencer.
4. Mr **William W. Naismith**, C.A., 57 Hamilton Drive, Hillhead. Recommended by Dr Freeland Fergus, Dr Oswald Fergus, and Professor Peter Bennett.

5. Mr JAMES A. ROSE, 11 Kirklee Road, Kelvinside. Recommended by Mr J. J. Spencer, Mr Charles L. Spencer, and Dr Freeland Fergus.

6. Mr FRED H. YOUNG, 2 Woodside Terrace. Recommended by Dr Oswald Fergus, Dr Freeland Fergus, and Professor Peter Bennett.

11th February, 1907.

A Special Meeting of the Royal Philosophical Society of Glasgow was held within the Rooms, 207 Bath Street, on the evening of Monday, the 11th February, 1907, at 8 o'clock. The President, Dr David Murray, occupied the chair.

The Meeting was called at the instance of the Economic Science Section for the purpose of discussing the question of "Shipping Conferences or Rings."

The discussion was opened by Bailie Bruce Murray and continued by Mr Gardiner, Mr Gaff, Mr C. T. Grant, Mr Barclay, Mr W. H. Kidston, Mr John A. Todd, Mr John A. Spens, Mr John Mann, jun., Mr Lewis Smith, and Mr Martin.

Bailie Bruce Murray replied, and a vote of thanks was passed to the speakers on the motion of the President.

13th February, 1907.

The Seventh Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 13th February, 1907, at 8 o'clock. The President, Dr David Murray, occupied the chair.

1. The Minutes of the last two Meetings, of dates 30th January, and 11th February, 1907, having been printed in the Billet calling the Meeting, were held as read, were approved, and were thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. Mr James Colville, M.A., D.Sc., read an appreciative notice of the late Professor James Blyth, M.A., LL.D., and was accorded a vote of thanks on the motion of the Chairman.

4. Mr John S. Samuel, J.P., F.R.S.E., read a paper entitled—"The Teaching of Scottish History: its Importance as a Scientific Study, and its Place in the Curriculum of Scottish Schools."

A discussion followed, in which part was taken by Dr Colville, Dr Hutchison, Dr Knight, Mr M'Leod, and Dr Murray.

The thanks of the Meeting were accorded to Mr Samuel on the motion of the Chairman.

5. The following gentlemen were declared by the President to have been duly elected to Membership of the Society:—

1. Mr WILLIAM G. GARDINER, 4 Buckingham Terrace, Glasgow. Recommended by Mr J. J. Spencer, Mr Charles L. Spencer, and Mr H. A. Mavor.
2. Mr JAMES MACARA, Banker, 140 St. Vincent Street. Recommended by Mr H. A. Mavor, Mr John Mann, Jun., and Mr John Mann.
3. Mr JOHN L. MORISON, M.A., The University, Glasgow. Recommended by Mr J. T. T. Brown, Dr George Neilson, and Mr John Clark.
4. Mr THOMAS Y. PATERSON, 4 Lorraine Gardens, Dowanhill, Glasgow. Recommended by Professor Magnus Maclean, Mr Daniel Murray, and Mr John F. Campbell.

27th February, 1907.

The Eighth Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 27th February, 1907, at 8 o'clock. The President, Dr David Murray, occupied the chair.

1. The Minute of previous Meeting, of date 13th February, 1907, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. Mr W. H. Beveridge, M.A., read a paper entitled—"Employment Exchanges as One Remedy for Unemployment," being a communication from the Economic Science Section.

In the discussion which followed, part was taken by Treasurer D. M. Stevenson Mr Thomas Jones, Miss J. G. Jones, Mr Nicholas M. Reid, Mr John F. Campbell, Mr W. W. Lackie, Superintendent Douglas, Mr H. A. Mavor, Mr R. H. Tawney, and Dr Murray.

Mr Beveridge replied, and was accorded a vote of thanks on the motion of the Chairman.

4. The Hon. Secretary intimated that

Mr Lewis O. Smith, 2 Windsor Terrace, West, recommended by Mr Geo. Barclay, Dr Freeland Fergus, and Professor Peter Bennett,

had been duly elected to Membership of the Society.

13th March, 1907.

The Ninth Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 13th March, 1907, at 8 o'clock. In the absence of the President, Mr H. A. Mavor, Vice-President, occupied the chair.

1. The Minute of previous Meeting, of date 27th February, 1907, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The New Member elected at the previous Meeting was duly admitted.

3. Dr Freeland Fergus read a paper on "Vision and Work." A discussion followed, in which part was taken by Dr Snodgrass, Dr Rowan, Dr W. L. Reid, Professor Glaister, Dr Knight, Mr Napier, Mr M'Killop, and Dr Fergus.

4. Professor John Glaister, M.D., read a paper entitled—"The Purification of Rivers." Dr John M'Vail, Dr Fergus, Mr G. Thomson, and Professor Glaister took part in a discussion which followed.

On the motion of the Chairman Dr Fergus and Professor Glaister were accorded a vote of thanks.

4. The Chairman intimated that

Mr Alexander Anderson, C.E., Farme Cottage, Rutherglen, recommended by Mr Dugald Bannatyne, Mr J. M'Lay, and Dr Freeland Fergus,

had been duly elected to Membership of the Society.

18th March, 1907.

A Special Meeting of the Royal Philosophical Society of Glasgow was held in the Rooms, 207 Bath Street, on Monday, the 18th March, 1907, at 5 p.m. In the absence of the President and Vice-Presidents, Mr J. A. Balfour took the chair by request.

Dr James Stirton, F.L.S., read a paper on "Scottish Mosses," and exhibited a number of specimens. Critical and appreciative remarks were made by Mr Lee and Mr Stewart, and a vote of thanks was accorded to Dr Stirton on the motion of the Chairman.

27th March, 1907.

The Tenth Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 27th March, 1907, at 8 o'clock. The President, Dr David Murray, occupied the chair.

1. The Minutes of the last two Meetings, of dates 13th and 18th March, 1907, having been printed in the Billet calling the Meeting, were held as read, were approved, and were thereupon signed by the Chairman.

2. The New Member elected at the previous Meeting was duly admitted.

3. Dr David Murray, President of the Society, delivered his Presidential Address, taking for his subject—"Early Burgh Organisation in Scotland as illustrated in the history of Glasgow and of some neighbouring Burghs."

At the close of the address a vote of thanks was accorded to Dr Murray on the motion of Professor Medley, seconded by Mr John Edwards.

10th April, 1907.

The Eleventh Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Wednesday, 10th April, 1907, at 8 o'clock. The President, Dr David Murray, occupied the chair.

1. The Minute of previous Meeting, of date 27th March, 1907, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The Chairman intimated that the reading of the paper on "The Prevention and Punishment of Crime" would be postponed as the Author, Chief-Constable Stevenson, had been called to London to give evidence before a Parliamentary Commission.

3. Dr Alexander Scott read a paper entitled "Supervision of Lads from their Fourteenth till their Seventeenth Year," being a communication from the Sanitary and Social Economy Section. Dr Henry Dyer, Professor Jamieson, Dr James Knight, Mr Broomhead, and Dr Murray took part in a discussion which followed the reading of the paper.

The thanks of the Meeting were accorded to Dr Scott on the motion of the Chairman.

4. The Hon. Secretary announced that

Mr JOHN MURDOCH, Chemist, 694 Duke Street, recommended by Mr John Garroway, Dr Freeland Fergus, and Mr Oswald Fergus,

had been duly elected to Membership of the Society.

30th April, 1907.

The Twelfth Ordinary Meeting, for Session 1906-1907, of the Royal Philosophical Society of Glasgow, was held within the Rooms, 207 Bath Street, on the evening of Tuesday, 30th April, 1907, at 8 o'clock. The President, Dr David Murray, occupied the chair.

1. The Minute of previous Meeting, of date 10th April, 1907, having been printed in the Billet calling the Meeting, was held as read, was approved, and was thereupon signed by the Chairman.

2. The annual election of office-bearers to fill the vacancies occurring by retirals took place, and the following appointments were unanimously made:—

1. President—Dr Freeland Fergus.
2. Vice-President—Dr William Snodgrass.
3. Four Ordinary Members of Council—Professor J. Graham Kerr, Dr George Neilson, Professor Thomas Gray, Mr Charles R. Gibson.
4. Hon. Treasurer—Mr John Mann.
5. Hon. Librarian—Dr James Knight.
6. Auditors—Mr A. S. Murray and Mr W. W. Naismith, C.A.

3. Mr David Ellis, Ph.D., D.Sc., read a paper entitled "Iron Bacteria and their connection with Stone-decay."

In a discussion which followed part was taken by Professor Bower, Dr R. M. Buchanan, Mr W. Fraser, Mr Napier, Mr Bromhead, Dr Murray, and Dr Ellis.

A vote of thanks was accorded to Dr Ellis on the motion of the President.

4. The Chairman intimated that, in terms of the Articles of Association, the Council had appointed Professor Peter Bennett Secretary of the Society.

5. The Chairman announced that

Mr JOHN T. FLEMING, M.A., 129 Bath Street, proposed by Mr John Clark, Mr J. T. T. Brown, and Dr George Neilson,

had been duly elected to Membership of the Society.

6. Mr Wm Fraser moved, and Professor Bower seconded, "That the heartiest thanks of this Meeting be accorded to Dr Murray for his various and valuable services to the Society during his term of office as President." The motion was cordially responded to.

7. The foregoing Minute was read by the Secretary and approved by the Meeting, and the Chairman authorised to sign it when it should be engrossed in the Minute-book.

OFFICE-BEARERS
OF THE
Royal Philosophical Society of Glasgow.

SESSION 1906-1907.

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Griefswald (Prussia)—
  Geographische Gesellschaft.

Halle (Prussia)—
  Vereins für Erdkunde zu Halle.
  Kaiserliche Leopoldino—Carolinische Deutsche Akademie der Naturforscher.

INDIA.

Calcutta—
  Geological Survey of India.

IRELAND.

Belfast—
  Belfast Naturalists' Field Club, Museum, College Square, North.
  Natural History and Philosophical Society, Museum, College Square, North.

Dublin—
  Royal Dublin Society, Leinster House.
  Royal Irish Academy, 19 Dawson Street.
  Trinity College Library.

ITALY.

Milan—
  Reale Istituto di Lombardo di Scienze, Lettere, ed Arti.

JAPAN.

Kyōto—
  Imperial University, College of Science and Engineering.

Tokio—
  Imperial University of Tokio, Science College.

JAVA.

Batavia—
  Royal Magnetical and Meteorological Observatory.

MEXICO.

Mexico—
- Instituto Geologico de Mexico.
- Observatorio Astronómico Nacional de Tacubaya.
- Observatorio Meteorologico-Magnetico Central.
- Sociedad Científica "Antonio Alzate."

MONACO.

Monaco—
- Musée Océanographique.

NETHERLANDS.

Amsterdam—
- Académie Royale des Sciences à Amsterdam.

Harlem—
- Musée Teyler.
- Société Hollandaise des Sciences à Harlem.

Leyden—
- Kon. Nederlandisch Aardrijkskundig Genootschap.

NEW ZEALAND.

Wellington—
- New Zealand Institute.

NORWAY.

Christiania—
- Kongelige Norske Frederiks Universitet.
- Videnskabs-Selskabet i Christiana.

ROUMANIA.

Bucharest—
- Societatiĭ de Sciinte Fizice.

RUSSIA.

Kazan—
- Imperial Kazan University.

St. Petersburg—
- Académie Impériale des Sciences.

SCOTLAND.

Aberdeen—
- Philosophical Society, 147 Union Street.

Alnwick—
- Berwickshire Naturalists' Club, W. J. Bolam, Berwick-on-Tweed, *per* George Bolam.

SCOTLAND—*continued.*

Edinburgh—
- Advocates' Library.
- Botanical Society of Edinburgh, Royal Botanic Garden.
- Geological Society, 5 St Andrew Square
- Highland and Agricultural Society of Scotland, 3 George IV. Bridge.
- Royal Physical Society, 1 India Buildings.
- Royal Scottish Geographical Society, Queen Street.
- Scottish Meteorological Society, 122 George Street.
- Royal Scottish Society of Arts, 117 George Street.
- Royal Society, The Mound, Princes Street.

Glasgow—
- Archæological Society, 88 West Regent Street.
- Baillie's Institution Free Library.
- Faculty of Physicians and Surgeons of Glasgow, 242 St Vincent Street.
- Geological Society, 207 Bath Street.
- Glasgow University—
- Glasgow and West of Scotland Technical College Library.
- Institute of Accountants and Actuaries in Glasgow.
- Institution of Engineers and Shipbuilders in Scotland, 207 Bath Street.
- Mitchell Library, Miller Street.
- Natural History Society of Glasgow, 207 Bath Street.
- Stirling's Public Library, Miller Street.
- West of Scotland Iron and Steel Institute.

Hamilton—
- Mining Institute of Scotland.

SWEDEN.

Upsala—
- Royal University Library.

Stockholm—
- Kongliga Svenska Vetenskaps-Akademie.

TASMANIA.

Hobart—
- Royal Society of Tasmania.

UNITED STATES.

Albany—
- New York State Department of Health.
- New York State Library.

Austin (Texas)—
- Texas Academy of Science.

Baltimore—
- Johns Hopkins University.

Berkeley (Cal.)—
- University of California. Exchange Department University Library.

UNITED STATES—*continued.*

Boston—
  American Academy of Arts and Sciences.
  Boston Society of Natural History.
  Library of the City of Boston, Copley Square.

Buffalo—
  Buffalo Society of Natural Sciences.

Chicago—
  Western Society of Engineers.

Colorado Springs—
  Coburn Library, Colorado College.

Columbia (Mo.)—
  University of Missouri. The Librarian.

Davenport (Iowa)—
  Academy of Natural Sciences.

Denver—
  Colorado Scientific Society.

Des Moines (Iowa)—
  Iowa Geological Survey.

Indianapolis (Ind.)—
  Indiana Academy of Science.

Lawrence (Kansas)—
  Kansas University.
  Columbus.
  Ohio State University.

Madison (Wis.)—
  Madison Geological and Natural History Society.
  Washburn Observatory.

Mount Hamilton (Cal.)—
  Lick Observatory.

Newhaven (Conn.)—
  Connecticut Academy of Arts and Sciences.
  Yale University.

New York—
  American Geographical Society, 15 Eighty-first Street.
  American Museum of Natural History, Seventy-seventh Street, and Central Park West.
  American Society of Civil Engineers, 220 West Fifty-seventh Street.
  New York Public Library, 40 Lafayette Place.
  New York Academy of Sciences Library, Seventy-Seventh Street, Central Park, West.
  School of Mines, Columbia College. The Associate Editor.

Philadelphia—
  Academy of Natural Science of Philadelphia.
  The Associated Alumni of the Central High School of Philadelphia.
  American Pharmaceutical Association.

UNITED STATES—*continued.*

Philadelphia—
  American Philosophical Society. The Hon. Secretaries, 104 South Fifth Street.
  Franklin Institute, 15 South Seventh Street.
  Numismatic and Antiquarian Society of Philadelphia.
  Wagner Free Institute of Science, corner of Seventeenth Street and Montgomery Avenue.

Rochester (N.Y.)—
  Rochester Academy of Science. Corresponding Secretary.

St. Louis (Mo.)—
  Academy of Science of St Louis, 3817 Olive Street.
  Missouri Botanical Garden.

Salem—
  American Association for the Advancement of Science.

San Francisco (California)—
  California Academy of Sciences.

Topeka (Kansas)—
  Kansas Academy of Science.

Washington—
  Bureau of Education (Department of the Interior).
  Bureau of Ethnology.
  Smithsonian Institution.
  United States Geological Survey.
  United States National Museum (Department of the Interior).
  United States Naval Observatory.
  United States (Department of Agriculture).
  Volta Bureau.

LIST OF PERIODICALS.

(Those received in exchange are indicated by an "a").

WEEKLY.

- Academy.
- Architect.
- Athenæum.
- British Journal of Photography.
- Builder.
- Building News.
- Chemical News.
- Comptes Rendus.
- County and Municipal Record.
- *a*Deutsche Kolonialzeitung.
- Dingler's Polytechnisches Journal.
- Electrical Review.
- Electrician.
- *a*Engineering.
- English Mechanic.
- *a*Illustrated Official Journal of Abridgments of Patents.
- *a*Journal of the Society of Arts.
- Journal of Gas Lighting.
- Lancet.
- La Nature.
- Nature.
- Notes and Queries.
- *a*Pharmaceutical Journal.
- *a*Publishers' Circular.
- Scientific American and Supplement.
- Zeitschrift für Angewandte Chemie.

FORTNIGHTLY.

- Annalen der Chemie (Liebig's).
- *a*Berichte der Deutschen Chemischen Gesellschaft.
- Journal de Pharmacie et de Chimie.
- Journal für Praktische Chemie.

MONTHLY.

- *a*American Chemical Journal.
- American Journal of Science.
- Analyst.
- Annalen der Physik.
- Annales de Chimie et de Physique.
- Annales de l'Institut Pasteur.
- Annales des Mines.
- Annales des Ponts et Chaussées.
- Annales des Sciences Naturelles—Botanique.
- Annales des Sciences Naturelles—Zoologie.
- Annals and Magazine of Natural History.
- Antiquary.
- Beiblätter zu den Annalen der Physik.
- Bulletin de la Société Chimique de Paris.
- Bulletin de la Société Géologique de France.
- Bulletin de la Société Industrielle de Mulhouse.
- Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
- Bulletin of the American Mathematical Society.
- *a*Canadian Entomologist.

MONTHLY—*continued.*

*a*Engineering Review.
*a*Electrical Magazine.
*a*Geographical Journal.
Geological Magazine.
*a*Johns Hopkins University Circulars.
Journal of Botany.
*a*Journal of the Chemical Society.
Journal of Education.
*a*Journal of the Franklin Institute.
*a*Journal of the Royal Photographic Society.
*a*Journal of the Society of Chemical Industry.
*a*Journal of the Western Society of Engineers.
Library Association Record.
Library World.
London, Edinburgh, and Dublin Philosophical Magazine.
Petermanns Mitteilungen.
Polytechnic Bibliothek.
*a*Proceedings of the Royal Society of London.
*a*Proceedings of the Society of Biblical Archæology.
Revue Universelle des Mines.
*a*Royal Astronomical Society's Monthly Notices.
Science Abstracts.
*a*Science of Man.
*a*Scottish Geographical Magazine.
*a*Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin.
*a*Tijdschrift van het Koninklijk Nederlandoch Aardrijkskundig Genootschap.
Zoologist.
Zeitschrift fur Analytische Chemie.

QUARTERLY.

Annals of Botany.
Annals of Scottish Natural History.
*a*Archives Néerlandaises des Sciences Exactes et Naturelles.
*a*Bulletin of the American Geographical Society.
*a*Bulletin of the Kansas University.
Economic Journal.
Englische Studien.
Jahrbuch über die Fortschritte der Mathematik.
Journal of Anatomy and Physiology.
*a*Journal of the Anthropological Institute of Great Britain.
*a*Journal of Manchester Geographical Society.
*a*Journal of the Royal Institute of British Architects.
Journal of the Royal Microscopical Society.
*a*Journal of the Royal Statistical Society.
*a*Journal of the Scottish Meteorological Society.
*a*Memorias Y Revista de la Sociedad Científica "Antonio Alzate."
Mind: a Quarterly Review of Psychology and Philosophy.
*a*Proceedings of the American Philosophical Society.
Quarterly Journal of Economics.
Quarterly Journal of Geological Society.
Quarterly Journal of Microscopical Science.
*a*Quarterly Journal of Royal Meteorological Society.
Quarterly Journal of Pure and Applied Mathematics.
Reliquary and Illustrated Archæologist.
Record of Technical and Secondary Education.
Revue Historique.
*a*School of Mines Quarterly.
Scottish Historical Review.
Scientific Roll.

ANNUALLY.

British Journal Photographic Almanac.
Hazell's Annual.
Jahres-Bericht Chemischen Technologie.
Journal of the Royal Agricultural Society of England.
Murray's English Dictionary.
*a*Journal de L'École Polytechnique.
Palæontographical Society's Publications.
Philosophical Transactions, Royal Society of London.
Ray Society's Publications.
Report of the Board of Education.
Statesman's Year Book.
Symons' British Rainfall.
Wright's English Dialect Dictionary.

The LIBRARY and the READING-ROOM are open:—Winter, 9.30 a.m. till 8 p.m. (except Saturdays); Saturdays, till 2 p.m.

Summer (May till October, except during the holidays, from the 11th till 31st July), 9.30 a.m. till 5 p.m.; Saturdays, till 1 p.m.

LIST OF MEMBERS

OF THE

Royal Philosophical Society of Glasgow

FOR 1906-1907.

HONORARY MEMBERS.

(*Limited to Twenty.*)

WITH YEAR OF ELECTION.

FOREIGN.

	Rudolph Albert von Kölliker, Würzburg.	1860
	Professor Ernst Heinrich Hæckel, Jena.	1880
	Professor Georg Quincke, Hauptstrasse 47, Friederichsbau, Heidelberg.	1890

AMERICAN AND COLONIAL.

	Robert Lewis John Ellery, F.R.A.S., Victoria, Australia.	1874
5	Thomas Muir, M.A., LL.D., F.R.S.S., L. and E., Superintendent General of Education, Cape Colony.	1892

BRITISH.

	Sir Joseph Dalton Hooker, C.B., G.C.S.I., M.D., D.C.L., LL.D., F.R.S., The Camp, Sunningdale.	1874
	The Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., F.R.S., F.R.A.S., F.R.S.G., Prof. of Nat. Philosophy in the Royal Institution, London, Terling place, Witham, Essex.	1890
	The Right Hon. Lord Lister, O.M., LL.D., D.C.L., F.R.S., 12 Park crescent, Portland place, London, W.	1895
	Sir Archibald Geikie, LL.D., D.Sc., F.R.S., F.R.S.E., F.G.S., Director-General of the Geological Survey of the United Kingdom, Shepherd's Down, Haslemere, Surrey,	1895
10	The Right Hon. Lord Kelvin, O.M., G.C.V.O., LL.D., D.C.L., F.R.S., Largs. (*Ordinary Member*, 1846 *till* 1896.)	1896
	Professor Edward Albert Schäfer, LL.D., F.R.S., M.R.C.S., University of Edinburgh.	1902
	Sir William Huggins, K.C.B., D.C.L.Oxon., LL.D.Camb., Pres. R.S., F.R.A.S., etc., 90 Upper Tulse-hill, London, S.W.	1904
	Sir William Ramsay, K.C.B., LL.D., D.Sc., Ph.D., F.R.S., Professor of Chemistry, University College, London, 19 Chester Terrace, Regent's Park, London, N.W.	1904

CORRESPONDING MEMBERS.

With Year of Election.

A. S. Herschel, M.A., D.C.L., F.R.S., F.R.A.S., Hon. Professor of Experimental Physics in the University of Durham; Observatory House, Slough, Bucks. - 1874
Thomas E. Thorpe, Ph.D., F.R.S., F.R.S.E., Principal of the Government Laboratories, Clement's Inn-passage, W.C. - - - - - - - - - 1874
John Aitken, LL.D., F.R.S., F.R.S.E., Ardenlea, Falkirk. - - - - - 1883
James Dewar, M.A., F.R.S., F.R.S.E., M.R.I., Jacksonian Professor of Physics, University of Cambridge, and Professor of Chemistry in the Royal Institution of Great Britain, 1 Scroope terrace, Cambridge. - - - - - - - 1883
5 Joseph W. Swan, M.A., D.Sc., F.I.C. F.C.S., M.I.Mech.E., Hon.M.I.E.E., F.R.S., 58 Holland Park, W. - - - - - - - - - - - 1883
William Milne, M.A., B.Sc., F.R.S.E., Department of Public Education, Cradock, Cape Colony. - - - - - - - - - - - 1894
Richard Lodge, M.A., Professor of History in Edinburgh University. - - - 1899
Edmund J. Mills, D.Sc., LL.D., F.R.S., Emeritus Professor of Technical Chemistry, Glasgow and West of Scotland Technical College, 64 Twyford avenue, West Acton, London, W. - - - - - - - - - - 1901
Arthur Schuster, Ph.D., F.R.S., Professor of Physics, Victoria University, Manchester, Victoria park, Manchester. - - - - - - - - - - 1901
10 W. S. M'Cormick, M.A., LL.D., 2 St Andrew's square, Edinburgh. - - - 1902
John George Bartholomew, F.R.S.E., F.R.G.S., Geographical Institute, Park road, Edinburgh. - - - - - - - - - - - - - - 1902
James Burgess, C.I.E., LL.D., F.R.S.E., Hon. A.R.I.B.A., F.R.G.S., 22 Seton place, Edinburgh. - - - - - - - - - - - - - - 1902
Francis Elgar, LL.D., F.R.S., F.R.S.E., 18 Cornwall Terrace, Regent's park, London, N.W. - - - - - - - - - - - - - - 1902
Frederick Emley, Literary and Philosophical Society of Newcastle-upon-Tyne. - 1902
15 Professor Cargill G. Knott, D.Sc., F.R.S.E., 42 Upper Gray street, Edinburgh. 1902
Principal John Yule Mackay, M.D., LL.D., University College, Dundee. - - 1902
Professor John Millar Thomson, LL.D., F.R.S., F.I.C., F.C.S., King's College, and 9 Campden Hill Gardens, London, W. - - - - - - - - 1902
Professor Robert Wallace, F.R.S.E, F.L.S., F.C.S., University of Edinburgh. - 1902

ORDINARY MEMBERS.

With Year of Entry.

a Denotes Life Members.

Adam, Stephen, 168 Bath street. 1896
*a*Adam, Thomas, F.S.I., 27 Union st. 1892
Adams, John, M.B., 1 Queen's crescent, W. 1902
Adams, William, Makerstoun, Bearsden. 1891
5 Addison, W. H., Superintendent Mount Florida Deaf and Dumb Institution. 1895
*a*Agar, Thomas F., Argentine Consul-General, 30 George square. 1896
Aiken, James, of Dalmoak, 201 West George street. 1905
Aikman, W. G., 12 Kingsborough gardens, Kelvinside. 1899
Aiton, Alexander Hamilton, 190 West George street. 1902
10 Alexander, D. M., 5 Derby crescent, Kelvinside. 1887
*a*Allan, Henry, 2 Park gardens. 1900
*a*Allan, James A., 25 Bothwell st. 1904
Allan, James W., M.B., 18 India street. 1900
Alston, J. Carfrae, 9 Lorraine gard. 1887
15 Anderson, Alexander, 157 Trongate. 1869
*a*Anderson, Alexander, C.E., Farme Cottage, Rutherglen. 1907
*a*Anderson, David H., Atlantic Mills, Bridgeton. 1904
Anderson, James, 4 Kingsborough gardens. 1900
Anderson, James, 168 George street. 1890
20 Anderson, James Scott, Bardowie Castle, Milngavie. 1902

Anderson, James Spencer, 81 Great Clyde street. 1901
Anderson, John, 142 West Nile st. 1884
Anderson, J. B. Mackenzie, M.B., 8 Buckingham terrace, Hillhead. 1895
Anderson, R. T. R., 42 Roselea drive. 1889
25 Anderson, Robert, 76 Bath street. 1896
Anderson, Robert, Eastwoodhill, Giffnock. 1900
*a*Anderson, Robert Locke, 233 St Vincent street. 1901
*a*Anderson, Sir T. M'Call, M.D., Professor of Practice of Medicine in the University of Glasgow, 9 The College. 1873
Anderson, Wm, 12 Princes square. 1900
30 *a*Anderson, William, 133 Wellington street. 1890
Anderson, W. F. G., 47 Union st. 1878
Anderson, William, J., C.A., 149 West George street. 1906
Andrew, Grant, 12 Woodside ter. 1900
*a*Andrew, James, 160 West George street. 1900
35 Angus, Robert, Ladykirk, Monkton, Ayrshire. 1901
*a*Annan, J. Craig, 518 Sauchiehall street. 1888
Annandale, Charles, M.A., LL.D., 35 Queen Mary avenue. 1888
Arend, Waldemar, 1 Queensborough gardens. 1904
Arneil, Allan, Stewarton drive, Cambuslang. 1901
40 *a*Arnot, J. L., 204 Bath street. 1890
Arrol, Theodore A., Torwood Hill, Row, Dumbartonshire. 1902
Arrol, Wm. A., Torwoodhill, Row. 1869
*a*Arrol, Sir William, LL.D., Seafield, Ayr. 1900
*a*Arthur, Andrew, 78 Queen street. 1902
45 *a*Arthur, James, 78 Queen street. 1900
Arthur, Sir Matthew, Bart., 78 Queen street. 1900

Baird, Allan F., 192 St. Vincent street. 1904
*a*Baird, J. G. A., M.P., Wellwood, Muirkirk. 1892
*a*Balfour, Alexander, Kelvindare, Kelvinside. 1900
50 Balfour, John A., F.R.Hist.S., Kelvindare, Kelvinside, Glasgow. 1907
Ballantine, George, jun., 100 Union street. 1897
Ballantyne, John H., 212 Bath street. 1904
Bannatyne, Dugald, C.A., 191 West George street. 1907
Barbour, Wm, M.B., C.M., 3 Edelweiss terrace, Partick. 1900
55 Barclay, A. J. Gunion, M.A., F.R.S.E., High School. 1893
Barclay, A. P., 133 St Vincent street. 1890
Barclay, George, 8 Windsor circus. 1891
Barclay, James, 16 Roxburgh street, Kelvinside. 1871
Barman, Harry D.D., 21 University gardens. 1904
60 Barnet, John, 73 Robertson street. 1901
*a*Barr, Archibald, D.Sc., Professor of Civil Engineering and Mechanics in the University of Glasgow, Royston, Dowanhill. 1890
*a*Barr, James, C.E., I M., F.S.I., 221 West George street. 1883
Barr, Patrick, 51 Bath street. 1902
Barr, Thos, M.D., F.F.P.S.G., 13 Woodside place, W. 1879
65 Barrett, Francis Thornton, Mitchell Library. 1880
Bauermeister, F., 49 Gordon street. 1901
Baxter, John, I.M., 243 St Vincent street. 1901
Baxter, W. R., 36 Sutherland terrace. 1900
Beardmore, W., Parkhead Forge. 1901
70 Beatson, George T., B.A. (Cantab.), M.D., 7 Woodside crescent. 1881
Beaumont, Frank, B.A.(Lond.), 19 Grantly gardens, Shawlands. 1904
Becker, L., Ph.D., Professor of Astronomy in the University of Glasgow, The Observatory. 1895
Beckett, Charles E., M.A., LL.B., 163 St Vincent street. 1903
Beckett, William, M.A., 225 West George street. 1900
75 Beedle, Peter D. Ridge, 18 Ashton gardens. 1902
Begg, Wm, 636 Springfield road. 1883
Beilby, George T., F.R.S., 11 University gardens, Hillhead. 1895
Bell, George, architect, 212 St Vincent street. 1900
*a*Bell, Henry, Mynthurst, Reigate, Surrey. 1876
80 Bell, Sir James, Bart, 135 Buchanan street. 1877
*a*Bell, James T., Woodbine, Blairmore, Argyleshire. 1896
*a*Bell, John J., Clyde Cottage, Craigendoran. 1896
*a*Bennett, Professor Peter, *Secretary*, 207 Bath street. 1900
Bennett, Robert J., Savoy park, Ayr. 1883
85 Bergius, Walter, C.E., 77 Queen street. 1897
Bergius, William M., 14 St. Enoch square. 1907
Berry, R. A., Professor of Chemistry, West of Scotland Agricultural College, 6 Blythswood square. 1906

*a*Biggart, Thomas, 105 West George street. 1900
*a*Bilsland, William, 28 Park circus. 1888
90 Binnie, Thomas, Junr., M.A., 3 Park Gate. 1903
*a*Birkmyre, John, Broadstone, Port-Glasgow. 1900
*a*Bishop, A. Henderson, Thornton hall, Lanarkshire. 1896
Black, J. Albert, Lagarie, Row. 1869
Black, Malcolm, M.D., 5 Canning place. 1880
95*a*Black, William Dunn, J.P., The Manor House, Wallington, Surrey. 1901
*a*Blackie, J. Alexander, 17 Stanhope street. 1881
*a*Blackie, J. Robertson, North Bank, Dowanhill. 1881
*a*Blackie, Walter W., B.Sc., The Hill House, Helensburgh. 1886
Blackwood, Matthew, Ardmore, Port-Glasgow. 1901
100 Blair, William, 24 St Vincent place. 1902
Bles, Edward J., B.A.(Cantab.), B.Sc.(Lond. and Vict.) Natural History Department, University of Glasgow. 1905
*a*Blyth, Robert, Balvonie, Skelmorlie. 1885
*a*Blythswood, The Rt Hon. Lord, Renfrew, *Hon. Vice-President.* 1885
Borthwick, James D., 46 Balshagray avenue, Partick. 1891
105*a*Boston, Alex. L., 12 Argyle arcade. 1902
Bottomley, James T., M.A., D.Sc., F.R.S., F.R.S.E., F.C.S., 13 University gardens, Hillhead. 1880
Bottomley, Wm, C.E., 15 University gardens. 1880
Bower, F.O., D.Sc., M.A., F.R.S., F.L.S., Regius Professor of Botany in the University of Glasgow, 1 St John's terrace, Hillhead. 1885
Bowers, John, *Depute* Town Clerk, City Chambers. 1904
110 Boyd, James, Boydston, Lenzie. 1905
Boyd, John, Shettleston Iron-works, near Glasgow. 1873
*a*Boyne, James, 106 West Nile street. 1901
*a*Broadfoot, William R., Inchholme Works, Whiteinch. 1900
Brock, Henry, Auchenheglish, Arden, Dumbartonshire. 1905
115 Brodie, William, B.L., 77 St Vincent street. 1902
Bromhead, Horatio K., F.R.I.B.A., I.A., 18 Kirklee road, Kelvinside. 1901
Brown, Alex., The Craigs, Carmunnock. 1896
Brown, George Arbuckle, M.B., C.M., D.P.H.(Camb.), 180 Hyndland road, Partick. 1900
*a*Brown, Hugh, 5 St John's terrace, Hillhead. 1887
120 Brown, James, 76 St Vincent street. 1876
Brown, John Armour, Moredun, Paisley. 1901
Brown, J. T. T., Kessiebank, Cambuslang. 1902
*a*Brown, Nicol Paton, 22 Belhaven ter. 1901
Brown, Richard, Writer, 166 St Vincent street. 1895
125 Brown, Robert, 19 Jamaica street. 1882
Brown, Wm, F.S.A.A., F.S.I., 138 West Regent street. 1901
*a*Brown, Wm Stevenson, 67 Washington street. 1886
*a*Brown, William, 165 West George street. 1892
Brown, Robert, B.Sc., 45 Washington street. 1893
130 Brownlee, Jno., M.D., Glasgow Fever Hospital, Belvidere. 1902
Brownlie, John Douglas, M.B., Ch.B., L.D.S., 10 Brandon place. 1901
Brownlie, J. Rankin, L.D.S. (Eng.), 220 West George street. 1892
Bruce, Alex., Clyne House, Pollokshields. 1901
Bruce, David, M.A., LL.B., 141 West George street. 1897
135 Bryce, John, Assoc. M.Inst.C.E., Maxwell street, Partick. 1900
*a*Buchanan, Andrew, Dunfillan, Helensburgh. 1902
*a*Buchanan, A. W. G., Parkhill, Polmont, Stirlingshire. 1903
Buchanan, George Douglas, Silverrae, Giffnock. 1901
Buchanan, Peter, 7 Garthland street. 1901
140 Buchanan, Robert Macneil, M.B., C.M., F.F.P.S.G., 2 Northbank terrace, Kelvinside. 1900
Buchanan, Walter, Clerkhill House, Dumbarton. 1901
*a*Buchanan, Wm. Enderley, Bearsden. 1886
Burnet, John James, A.R.S.A., F.R.I.B.A., 70 University avenue. 1892
Burns, J., M.D., 15 Fitzroy place, Sauchiehall street. 1864
145 Burns, James, 2 Caird drive, Partick. 1905
*a*Burrell, Wm, 54 George square. 1900
Burton, William L., 6 Richmond crescent, Glasgow. 1899
Burr, Robert A., M.A., B.Sc., 77 Sinclair drive, Langside. 1904

Caird, Robert, LL.D., F.R.S.E., 56 Esplanade, Greenock. 1898
150 Calder, William Ramsay, 102 Hope street. 1901
*a*Caldwell, George B., Scotia Leather Works, Boden street. 1892

Caldwell, James, M.P., 6 Newton place. 1900

Cameron, Sir Hector C., M.D., Professor of Clinical Surgery, University of Glasgow, 200 Bath street. 1873

*a*Campbell Arch., Springfield quay. 1895

155 *a*Campbell, J. A., LL.D., M.P., Stracathro, Brechin. 1848

Campbell, James Murdoch, 147 George street. 1901

Campbell, John, 49 St Andrew's drive, Pollokshields. 1901

*a*Campbell, John Ferguson, 15 Montgomerie street, North Kelvinside. 1892

Campbell, John M., F.E.I.S., Kennedy St Public School, and 14 Royal crescent, Crosshill. 1900

160 Campbell, John MacNaught, C.E., F.Z.S., F.R.S.G.S, 6 Franklin terrace, Dumbarton road. 1883

Campbell, Malcolm, 18 Gordon street. 1894

Campbell, M. Pearce, 9 Lynedoch crescent. 1905

Campbell, Joseph Dawson, 142 West George street. 1903

*a*Campbell, Thomas, Maryhill Iron works. 1894

165 Campbell, The Right Reverend Archibald E., D.D., Bishop's House, Woodside terrace. 1904

Cant, James, Kilmeny, Ardrossan. 1901

Carmichael, Neil, M.D., C.M., F.F.P.S.G., Invercarmel, 177 Nithsdale road, Pollokshields. 1873

Carrick, John, 26 Renfield street. 1905

Carson, D. S., C.A., J.P., St. Oswalds, Kilmacolm. 1905

170 Carswell, John, F.F.P.S.G., L.R.C.P.Ed., 5 Royal crescent, W. 1903

Carver, Thomas, A.B., B.Sc., D.Sc., C.E., 8 Windsor quadrant, Kelvinside. 1890

*a*Cayzer, Sir Charles W., M.P., 109 Hope street. 1886

Chalmers, A. K., M.D., D.P.H. (Camb.), 7 Buckingham terrace. 1892

Chalmers, James, I.A., 93 Hope st. 1884

175 Chalmers, P. MacGregor, I.A., F.S.A.Scot., 95 Bath street. 1891

*a*Chisholm, Sir Samuel, Bart., LL.D., 20 Belhaven terrace. 1890

Christie, James Roberton, M.A., LL.B., 3 Gloucester place, Edinburgh. 1903

*a*Christie, Henry W., 46 West George street. 1892

Christie, John, Turkey-red Works, Alexandria, Dumbartonshire. 1868

180 Christie, Wm. E., M.A., 47 Millbrae road, Langside. 1903

*a*Christison, George, 13 Cambridge drive. 1897

Chrystal, W. J., F.I.C., F.C.S., Shawfield Works, Rutherglen. 1882

Clanachan, John, 4 Lloyd street, Dennistoun. 1900

Clapperton, Alan E., 91 West Regent street. 1905

185 Clark, John, Ph.D., F.I.C., F.C.S., 138 Bath street. 1870

Clark, John, M.A., 24 Park gardens, N. Broomhill. 1897

Cleghorn, Alexander, 14 Hatfield drive, Kelvinside. 1904

*a*Cleland, John, M.D., LL.D., D.Sc., F.R.S., Professor of Anatomy in the University of Glasgow. 1884

*a*Coats, Archibald, Woodside, Paisley. 1900

190 Coats, John J., M.A.. 27 Woodside place. 1900

*a*Coats, Sir Thomas Glen, Bart., M.P., Ferguslie, Park, Paisley. 1905

Coghill, William C., 24 Douglas street. 1873

Colquhoun, Walter, M.A., M.B., C.M., 7 Stanley street, W. 1900

*a*Colville, Archibald, The Moorings, Motherwell and Arngomery, Kippen. 1905

195 Colville, James, M.A., D.Sc., 14 Newton place. 1885

Colville, David, Jerviston House, Motherwell. 1905

*a*Combe, James Russell, 10 Camphill avenue, Langside. 1895

*a*Connell, Charles Broadfoot, Scotstoun Shipbuilding Yard, Whiteinch. 1900

*a*Connell, James G., 44 St Enoch's square. 1900

200 Cook, William, 77 St Vincent street. 1900

Cooper, David, Woodend, Giffnock. 1905

Core, Wm, M.D., Stobhill Hospital, Springburn. 1891

Cormack, J. D., B.Sc., Prof. of Mechanical Engineering, University College, Gower st., London, W.C. 1898

Corrie, David, F.C.S., "Nobels," Polmont Station. 1902

205 Costigane, J. T. Stewart, Limekilns House, East Kilbride. 1889

Costigane, William, Clifton hall, Albert drive, Pollokshields. 1890

Coubrough, A. Sykes, Blanefield, Stirlingshire. 1869

Coulson, W. Arthur, 47 King street, Mile-end. 1888

Couper, James, Craigforth House, Stirling. 1862

210 Couper, Sinclair, Moore Park Works, Helen street, Govan. 1896

Cowie, Archibald, 20 Blythswood square. 1900
Craig, T. A., C.A., 139 St Vincent street. 1886
*a*Crawford, R. C., 12 Derby crescent, Kelvinside. 1902
Cree, Thomas S., LL.D., 21 Exchange square. 1869
215*a*Crookston, George B., 188 St Vincent street. 1900
Crosbie, Warren, B.L., 141 St. Vincent street. 1904
Cross, Alexander, M.P., 14 Woodlands terrace. 1887
*a*Crum, Walter G., Auchenboune, Bannockburn. 1895
Crum, William G., Dalnotter House, Old Kilpatrick. 1896
220*a*Cullen, Alexander, F. R. S. E., F. R. I. B. A., 3 Blythswood square. 1901
*a*Curphey, Wm Salvador, 7 Derby crescent, Kelvinside. 1883
Currie, John, 31 Westbourne gardens. 1905

Dalrymple, James D. G., F.S.A., Meiklewood, Stirling. 1902
*a*Daly, James, 2 Prince's gardens. 1898
225*a*Dalziel, T. Kennedy, M.B., C.M., 196 Bath street. 1896
Dansken, A. B., 109 St. Vincent street. 1877
Davidson, David, 7 Bute Mansions, Hillhead. 1905
Davie, Alexander, 220 St Vincent street. 1906
Dewar, David, 951 Sauchiehall street. 1903
230 Dick, Thomas, 166 St Vincent street. 1901
Dickie, John S., 30 Renfield street. 1900
*a*Dixon, James S., Fairleigh, Bothwell. 1900
Dixon, Walter, Derwent, Kelvinside gardens. 1893
Dixon, W. Macneile, M.A., Litt.D., Professor of English Language and Literature in the University of Glasgow, 2 South Park terrace, Hillhead. 1906
235 Dobbie, A. B., M.A., 24 West Cumberland street. 1885
*a*Dobbie, Robert, Beechmount, Larbert. 1900
*a*Donald, James Addie, 12 Waterloo street. 1900
Donald, John, 162 West Princes street. 1872
Donald, William, J. A., Devonport, Greenfaulds, Cumbernauld. 1877
240 Douglas, Campbell, I.A., F.R.I.B.A., 226 St. Vincent street. 1870
Douglas, James R., 43 Queen Mary avenue. 1907
Douglas, William M., 155 North street. 1903.
Downie, J. Walker, M.B., C.M., 4 Woodside crescent. 1901
Downie, Robert, jun., Carntyne Dyeworks, Parkhead. 1872
245 Downie, Thomas, Hydepark Foundry. 1886
*a*Dreghorn, David, Greenwood, Pollokshields. 1896
*a*Duncan, Eben., M.D., C.M., F.F.P.S.G., Queen's Park house, Langside road, *Hon. Vice-President.* 1873
Duncan, Hugh, M.A., LL.B., 54 West Nile street. 1895
Duncan, J. A., Aston, Bridge of Allan. 1896
250*a*Duncan, Robert, Whitefield Works, Govan. 1890
Dunlop, David John, Inch Works, Port-Glasgow, and 198 Bath street. 1900
Dunlop, John, F.E.I.S., headmaster, Quarry Brae Public School, Parkhead. 1900
Dunlop, John, M.D., 1 Somerset place. 1900
*a*Dunlop, Sir Nathaniel, 25 Bothwell street. 1870
255*a*Dunlop, Thomas, 70 Wellington street. 1902
Dunn, Hugh Shaw, Earlston Villa, Caprington, Kilmarnock. 1901
Dunn, Robert Hunter, 4 Crown terrace, Dowanhill. 1878
Dyer, Henry, M.A., D.Sc., C.E., 8 Highburgh terrace, Dowanhill. 1883

*a*Edington, George Henry, M.D., M.R.C.S. (Eng.), F.F.P.S.G., 20 Woodside place. 1896
260 Edmiston, John C., M.D., F.F.P.S.G., 24 Wilton gardens. 1901
*a*Edwards, John, 4 Great Western terrace, west. 1883
Elliott, Joseph J., City Chambers. 1901
Ellis, David, D.Sc. (Lond.), Ph.D. (Marburg), Lecturer in Botany, Technical College, Glasgow, 13 Princes street, Pollokshields. 1905
Erskine, Jas, M.A., M.B., L.F.P.S.G., 351 Bath street. 1886
265 Ewan, Thomas, M.Sc., Ph.D., 57 Montgomery street, Kirklee, Glasgow. 1901
Ewing, James C., 14 Woodlands road. 1902
*a*Ewing, Wm, 45 Renfield street. 1883

*a*Faill, John, 7 Winton drive, Kelvinside. 1901
Fairweather, Wallace, C.E., 62 St. Vincent street. 1880
270 Falconer, John M., Broomhill road, Partick. 1906
Falconer, Patrick, 13 Sutherland street, Hillhead. 1876
Falconer, Thos, 50 Kelvingrove street. 1880
*a*Farquhar, Jas T., 47 Hope street. 1901
Farquhar, Wm R., St Malo, Kilmalcolm. 1892
275 Farrelly, John, 25 Elmbank cres. 1901
Fawsitt, Charles A., 9 Foremount terrace, Partick. 1879
*a*Fergus, Freeland, M.D., F.R.S.E., F.F.P.S.G., *Hon. Secy.*, 22 Blythswood sq. 1887
Fergus, James, 58 York street. 1901
*a*Fergus, Oswald, D.D.S., L.D.S., F.R.S.E., 12 Clairmont gardens. 1896
280 Ferguson, Alexr., 164 Howard st. 1901
Ferguson, David, Glenholm, Port-Glasgow. 1901
Ferguson, Fergus, 20 Royal terrace, West. 1900
Ferguson, George, 130 Bishop street, Port Dundas. 1904
*a*Ferguson, John, M.A., LL.D., F.R.S.E., Professor of Chemistry, University of Glasgow, *Hon. Vice-President.* 1869
285 Ferguson, John A., Kilmeny, Kirklee, Glasgow. 1905
Ferguson, John Forbes, 166 St Vincent street. 1895
Findlay, Joseph, Clairmont, Winton drive, Kelvinside. 1873
Fleming, Dr Robert H., 19 Newton street, Charing cross. 1901
*a*Fleming, E. Brown, Lochanbrae, by Garelochhead. 1900
290*a*Fleming, Sir James, 136 Glebe st. 1880
*a*Fleming, John, 241 St Vincent st. 1900
Flower, Collingwood, Auchnacrioch, by Yoker, Renfrewshire. 1901
*a*Forrester, Henry, 105 West George street. 1900
Foster, W. A., St Catherines, Newlands road, Langside. 1899
295 Fotheringham, T. B., 52 Barrland street, Maxwell road. 1889
*a*Fowler, John, 164 St. Vincent street. 1880
Fraser, Melville, 31 St Vincent place. 1890
*a*Fraser, Thomas Smellie, F.S.I., 209 St Vincent street. 1900
*a*Fraser, Wm, F.S.I., 209 St Vincent street. 1900
300 Freebairn, J. B., M.A., Napiershall Public School. 1900
*a*French, Thomas, 1 Kelvinside ter. 1897
Frew, Alex., C.E., Assoc. M. Inst. C.E., 216 West George street 1876
*a*Frew, William, Ph.D., c/o H. Whiteway, Esq., The Orchards, Whimple, Devon. 1898
Fryers, Arthur John, 22 Bath street, Largs. 1899
305 Fullarton, Professor Robert, M.A., M.B., F.F.P.S.G., 272 Bath st. 1903
*a*Fullerton, Robt., M.D., 24 Newton place. 1896
Fulton, James, The Glen, Paisley. 1897
Fulton, James, 33 Hamilton drive, Hillhead. 1902
Fyfe, A. Peden, 124 St Vincent st. 1900
310 Fyfe, Henry B., 115 St Vincent st. 1892
Fyfe, John W., F.S.I., 221 West George street. 1905

*a*Gairdner, C. D., C.A., 115 St Vincent street. 1886
Galbraith, John Alexander, 28 Belhaven terrace. 1902
Galbraith, Peter, 4 Beaumont Gate, Dowanhill. 1889
315 Galbraith, Walter M., 7 Holyrood crescent. 1893
Galloway, T. Lindsay, C.E., 175 West George street. 1881
Galt, Professor Hugh, B.Sc.. M.B., C.M., F.F.P.S.G., D.P.H.(Camb.), 14 Berkeley terrace, W. 1900
Gardiner, F. C., 24 St. Vincent place. 1907
Gardiner, William G, 4 Buckingham terrace, Glasgow. 1907
320 Gardner, Alexander, Architect, 134 Bath street. 1906
Gardner, Daniel, 36 Jamaica street. 1869
Gardner, John, 146 Trongate. 1901
Gardner, John R., 33 Huntly gardens, Kelvinside. 1900
*a*Garrett, Geo., Dunbeth lodge, Coatbridge. 1901
325*a*Garrow, James R., 6 Pollok road. 1890
*a*Garroway, John, 694 Duke st. 1875
Gemmill, James Fairlie, M.A., M.D., 21 Endsleigh gardens. 1901
Gemmill, William, 140 Woodstock avenue, Shawlands. 1903
Gibson, Charles R., Lynton, Mansewood, by Pollokshaws. 1895
330 Gibson, James, M.A., Head Master, Woodside Public School. 1905
Gibson, William, 17 Wilton mansions. 1896
Gillies, F. H., Thornly Park, Potterhill, Paisley. 1905
*a*Gillies, William, 23 University gardens. 1901
Gillies, W. D., 17 Royal Exchange square. 1872

335 Glaister, John, M.D., F.F.P.S.G., D.P.H. (Camb.), F.R.S.E., F.C.S., &c., Professor of Forensic Medicine and Public Health, University of Glasgow, 3 Newton place. 1879
*a*Glaister, Joseph Newbigging, M.B., C.M., 4 Grafton place. 1900
*a*Glen, Lawrence, 153 St Vincent st. 1900
*a*Glen, Robert, Carlston, Kelvinside. 1901
Goldie, James, 52 St Enoch square. 1883
340 Goodwin, Robert, C.E., 3 Lynedoch street. 1875
Goold, James B., Bank of Scotland, Trongate. 1902
Gordon, H. E., Aikenhead House, Cathcart. 1906
*a*Gordon, James, Stonebyres, 14 Aytoun road, Pollokshields. 1901
*a*Gourlay, Charles, B.Sc., A.R.I.B.A., Professor of Architecture, Glasgow Technical College, 30 Hamilton drive, Hillhead. 1900
345 Gourlay, Robert, LL.D., 5 Marlborough terrace. 1904
Gow, Leonard, 45 Renfield street. 1889
Gow, Leonard, jun., 45 Renfield street 1884
Gow, Robert, 3 Victoria circus, Dowanhill gardens. 1860
Graham, Sir John Hatt Noble, Larbert House, Stirlingshire. 1900
350*a*Graham, Robert, 108 Eglinton st. 1888
*a*Graham, William, B.L., 198 West George street. 1885
*a*Graham, William, C.A., 6 Royal crescent, W. 1900
Graham, Wm Edward Auld, 7 Royal Bank place. 1900
Grant, Rev. James Bell, B.D., 113 Hill street, Garnethill, St. Stephen's Parish Church. 1903
355 Graves, John William, Hydropathic, Kilmalcolm. 1901
Gray, Albert A., M.D., 14 Newton terrace. 1903
Gray, Andrew, 30 Bath street. 1889
Gray, Andrew, LL.D., F.R.S., Professor of Natural Philosophy in Glasgow University, *Vice-President* 1899
*a*Gray, Thomas, D.Sc., Ph.D., F.I.C., F.C.S., Professor of Technical Chemistry, Glasgow Technical College. 1904
360*a*Gregory, Professor J. W., D.Sc, F.R.S., Glasgow University. 1904
Green, George, J.P., 40 Balshagray avenue, Partick. 1900
Greer, Thomas Arthur, Fairfield works, Govan. 1901
Greig, James R., Ravenswood, Crosshill. 1897
Grier, R. P., 7 Royal Bank place, Buchanan street. 1901
365 Grieve, W. Weir, 6 Bowmont terrace, Kelvinside. 1905
Grove, John, jun., 199 St Vincent st. 1902
Gumprecht, John, 6 Park quadrant. 1900
Gunn, John, B.L., 144 Bath street. 1901
Guthrie, David Wm., 166 Buchanan street. 1900
370 Guthrie, John, 17 Whittinghame drive, Kelvinside. 1901
Guy, Robert, 120 West Regent st. 1905

Hall, Colonel Peter Wishart, V.D., Arisaig, Craigendoran, Helensburgh. 1901
*a*Hamilton, John, I.A., 212 St Vincent street. 1885
Hanbidge, James E., 104 Queen's drive, Crosshill. 1897
375 Harington-Stuart, R. E. S. (Colonel), Torrance, East Kilbride, N.B. 1900
Harrington, John C., 3a So. Hanover street. 1901
*a*Harrington, J. P., Broadfield, Port-Glasgow. 1900
Harris, F. W., 32 Kyle Park, Uddingston. 1900
Harrison, John, J.P., 7 Granby ter. 1900
380 Harvey, William Ure, Norman Hurst, Bearsden. 1896
Harvie, William, 50 Belmont gardens, Hillhead. 1888
Hedley, H. A., 9 Derby crescent, Kelvinside. 1905
*a*Henderson, Andrew, 15 Cadogan st. 1906
*a*Henderson, A. P., 20 Newton place. 1880
385 Henderson, Francis, St Vincent place 1901
Henderson, George G., M.A., D.Sc., F.I.C., F.C.S., Professor of Chemistry, Glasgow and West of Scotland Technical College, 204 George street. 1883
Henderson, John, Reigate, Surrey. 1890
*a*Henderson, Thomas, 1 Lancaster crescent, Kelvinside. 1900
Henderson, Thomas Beath, M.D., 25 Lansdowne crescent. 1899
390*a*Henderson, William, 15 Cadogan street. 1873
Hendry, Geo. Scott, 310 St. Vincent street. 1895
Henry, R. W., 21 Oakfield terrace, W. 1875
Hewat, Andrew, J.P., 9 Berkeley terrace. 1906
Higgins, Henry, jun., 248 West George street. 1878
395 Hill, Thomas N., F.S.I., 180 Hope street. 1905

Hinshelwood, James, M.A., M.D., 26 Woodside place. 1896
Hinshelwood, Thomas, Kennyhill house, Dennistoun. 1903
Holmes, Daniel T., B.A., Ingleholm, Bridge of Weir. 1898
Honeyman, P. S., 12 South Park terrace. 1900
400*a*Hope, James, Dean house, Lenzie. 1898
Horne, Joseph, M.B., C.M., 45 Windsor terrace. 1900
*a*Houldsworth, J. H., Rozelle, Ayr. 1900
*a*Houldsworth, Wm Thos, Clerk in Holy Orders, 1 Mansfield street, Portland place, London, W. 1901
Houstoun, Wm Henry, Hillcrest, Cambridge drive. 1895
405 Howat, William, 37 Elliot street. 1885
*a*Hunt, John, Milton of Campsie. 1881
*a*Hunter, Richard H., Glentyan, Kilbarchan, Renfrewshire. 1900
Hunter, Robert, 72 Waterloo street. 1901
Hunter, Walter K., M.D., 7 Woodside place. 1899
410*a*Hunter, Wm S., 70 Robertson st. 1889
Hutchison, John C., 8 Lansdowne crescent. 1900
Hutchison, Joseph, Woodside, Netherburn, Lanarkshire. 1901
Hutton, James, C.A., 203 West George street. 1897
Hutton, W. K., M.A., M.B, Senior Demonstrator of Anatomy, The University. 1900
415*a*Hyslop, William, of Bank, New Cumnock. 1901

Inglis, John, LL.D., Pointhouse Shipyard. 1895
*a*Inglis, Malcolm, 48 St Andrew's sq. 1900
Inglis, R. A., Culrain, Bothwell, 1889
Innes, Gilbert, 16 Kirklee road, Kelvinside. 1900
420 Inverclyde, The Right Hon. Lord, 30 Jamaica street. 1905
*a*Irons, Joseph Jones, Summerlea, Kilcreggan. 1902

Jack, George, 12 Melrose gardens, Kelvinside. 1905
Jack, William Robert, M.D., 43 Lansdowne crescent. 1899
*a*Jack, William, M.A., LL.D., Professor of Mathematics in the University of Glasgow. 1881
425*a*Jackson, Harold D., Easterhill, Helensburgh. 1902
Jackson, Robert, 16 Dixon avenue, Crosshill. 1902
Jackson, Thomas, C.A., 24 George square. 1900
Jamieson, Andrew, F.R.S.E., M.Inst.C.E., M.Inst.E.E., etc., 16 Rosslyn terrace, Kelvinside. 1881
Jenkins, James Graham, Airedale, Cambuslang. 1901
430 Johnston, Alex., M.D. (Glasgow), D.P.H. (Camb.), Ruchill Hospital. 1900
Johnston, David, 160 West George street. 1891
Johnston, Michael, 19 Waterloo st. 1903
Johnston, William G., Anchor Chemical Works. 1901
Jones, Thomas, M.A., Anwylfan, East Kilbride. 1906
435 Jubb, John, B.L., 190 West George street. 1902

Kay, Arthur, J.P., Tregortha, Winton drive. 1904
Kay, Cathcart, 77 St Vincent street. 1900
Kay, Thomas, M.B., C.M., 5 Rosebery terrace. 1899
Kean, James, 31 Scotia street, Garnethill. 1888
440 Kedie, Robert, 11 Eglinton drive, Kelvinside. 1905
*a*Kelly, Alexander, 100 Hyde Park street. 1901
Kelly, Hugh, M.D., Catrine Bank, Shields road, Pollokshields. 1898
Kelly, James K., M.D., F.F.P.S.G., Park villa, Queen Mary avenue, Crosshill. 1889
Kelly, John Davidson, M.A., Stanley house, Bridge-of-Allan. 1901
445 Kemp, Wm (Alexander, Fergusson, & Co., Ltd), Ruchill, Maryhill. 1898
*a*Kennedy, Alexander, Kenmill House, Bothwell. 1902
Kennedy, James, 43 Greendyke st. 1889
Kennedy, John, Airdrie. 1904
*a*Kennedy, Moses Hunter, 217 West George street. 1901
450*a*Kennedy, William, Partick, 13 Victoria crescent, Dowanhill. 1900
*a*Ker, Charles, M.A., C.A., 115 St Vincent street. 1885
*a*Ker, Wm, 1 Windsor terrace, Kelvinside, West. 1874
Kerr, John G., M.A., LL.D., 15 India street. 1878
Kerr, J. Graham, M.A., Professor of Zoology University of Glasgow, 12 Oakfield terrace, Hillhead. 1904
455 Kerr, William, 260 West George street. 1902
Kidston, Geo. J., Finlaystone, Langbank. 1900
Kidston, J. B., 50 West Regent st. 1905
*a*Kidston, William H., 81 Great Clyde street. 1900

*a*Kiep, Johannes N., Imperial German Consul, 137 West George street. 1900

460*a*King, Chas M., Antermony house, Milton of Campsie. 1900

King, Sir James, Bart, LL.D., of Campsie, 115 Wellington street. 1855

King, John, 17 Queen's crescent. 1895

King, John C., 21 Newton place. 1898

King, Professor L. A. L., 8 Ardgowan terrace, Sandyford. 1905

465 King, Robert, 115 Wellington st. 1905

Kirk, Robert, M.D., Newton cottage, Partick. 1877

Kirk, Rev. Edward Bruce, E.U. Manse, Barrhead. 1905

Kirkpatrick, Alexander B., 88 St Vincent street. 1885

Kirkwood, James, Carling lodge, Ibrox. 1890

470 Knight, James, M.A., D.Sc., F.C.S., F.G.S., F.E.I.S., The Shieling, Uddingston. 1893

*a*Knox, David J., 19 Renfield street. 1890

Knox, John, Finnieston School. 1900

*a*Knox, John, 13 Montgomerie quadrant, Kelvinside. 1902

Lackie, W. W., 75 Waterloo street. 1905

475 Laird, John, Royal Exchange Sale Rooms. 1879

Lamb, David, 155 Hyndland road. 1896

Lamberton, Alex., Lylestone, Hamilton drive, Pollokshields. 1900

Lamberton, Andrew, Blairtummock, Easterhouse. 1904

Lamberton, Hugh Alexander, Lylestone, Pollokshields. 1901

480*a*Lamberton, Hugh, Surbiton, 52 Dalziel drive, Pollokshields. 1900

Lambie, Robert, Strathview, Larkhall. 1901

Lamond, Robert, M.A., LL.B., 163 West George street. 1894

Lang, William, Crosspark, Partick. 1865

*a*Langlands, E. W., 131 West Regent street. 1902

485*a*Lauder, James, F.R.S.L., Glasgow Athenæum. 1892

*a*Lauder, John, 46 Gordon street. 1894

Laughland, David, Linwood House, Linwood, Renfrewshire. 1901

Laurie, Malcolm, B.A., D.Sc., F.L.S., Professor of Zoology, The Bloom, Canaan lane, Edinburgh. 1901

Law, A. Bonar, M.P., Kintillo, Helensburgh. 1905

490 Law, Jas. H., Brandon House, Ibrox. 1901

Law, John, R. K., 20 Ashton gardens, Dowanhill. 1896

Lawrie, Sir Archibald C., LL.D., The Moss, Dungoyne, Stirlingshire. 1905

*a*Lawson, Thomas, Birchgrove, Pollokshields. 190

*a*Lindsay, Archd M., M.A., 87 West Regent street. 187

495*a*Lindsay, John, Conylea, Westbourne gardens, Kelvinside. 190

Lipton, Sir Thomas J., Bart., K.C.V.O., Grand Officer of the Crown of Italy, Osidge, Southgate, Middlesex. 1905

Lobban, William, M.A., 48 University avenue, Hillhead. 1905

Lochhead, Dugald Ferguson, 41 Kelvinside gardens, Kelvinside. 1902

Logan, James, Grammar School, Uddingston. 1902

500 Lothian, A. Veitch, M.A., B.Sc., F.R.S.E., Lecturer, Glendoune, Bearsden. 1891

Love, James Kerr, M.D., C.M., 173 Bath Street. 1888

Love, Wm., 28 Royal Exchange square. 1901

*a*Low, Isaac, 60 Weaver street. 1898

*a*Lumsden, Harry, M.A., LL.B, 105 West George street. 1900

505 Lumsden, James, Arden House, Arden, Dumbartonshire. 1905

Lundholm, C. O., Nobel's Explosives Factory, Ardeer, Stevenston. 1890

M'Ara, Alexander, 65 Morrison st. 1888

Macara, James, 19 Waterloo street. 1901

Macara, James, Banker, 140 St. Vincent street. 1907

510 M'Arly, Thomas, 29 W. George st. 1897

*a*M'Arthur, John S., 74 York street. 1890

M'Ausland, William F., 51 Buchanan street. 1903

Macbean, Ed, F.R.G.S., F.R.S.L., 31 Athole gardens. 1901

M'Bryde, Peter, M.B., 18 Queen's crescent, W. 1900

515 M'Calman, George, 1 India st., W. 1905

*a*M'Callum, Hugh, M.A., 7 Bute Mansions, Hillhead. 1902

*a*M'Callum, Robert, junr., 69 Union street. 1891

*a*M'Clelland, Andrew Simpson, C.A., 4 Crown gardens, Dowanhill. 1884

M'Conville, John, M.D., 14 Parkgrove terrace. 1870

520 M'Connachie, John, 204 West George street. 1905

M'Cosh, Andrew K., Cairnhill, Airdrie. 1901

*a*M'Cowan, David, jun., 9 Park circus place. 1898

M'Cracken, James, 5 Bowmont terrace, Kelvinside. 1889

M'Crae, John, 7 Kirklee gardens, Kelvinside. 1876
525 M'Creath, James, M.E., 208 St Vincent street. 1874
M'Culloch, Hugh, 154 W. Regent st. 1880
M'Donald, Alexander Beith, M.Inst. C.E., city engineer, City Chambers. 1901
MacDonald, Charles, 55 Lochleven road, Langside. 1902
*a*M'Donald, John, 72 Great Clyde st. 1896
530*a*Macdougall, Robert, F.S.A.A., F.S.I., 138 West Regent street. 1900
M'Elligott, John, 4 Victoria drive, Mount Florida. 1901
*a*M'Ewen, Robert, 11 Park terrace. 1900
Macfarlane, Dr Wm D., 17 Woodside crescent. 1906
Macfarlane, Dr Wm D., Jun., 17 Woodside crescent. 1906
535*a*Macfarlane, Walter, 22 Park circus. 1885
M'Farlane, Wm, Edna Lodge, Rutherglen. 1888
Macfee, John, M.I.E.E., 65 Renfield street. 1905
Macgeorge, B. B., 24 George square. 1905
MacGillivray, Duncan, M.A., 37 Leven street, Pollokshields. 1906
540*a*M'Gilvray, R. A., 129 West Regent street. 1880
M'Gregor, A. N., M.D., 14 Woodside place. 1900
MacGregor, D. O., M.D., Victoria Infirmary. 1904
*a*Macgregor, R. D., 137 West George street. 1900
Machell, Thomas, 1 Burnbank ter. 1886
545*a*Macindoe, Alex., 104 West George street. 1894
Macintyre, John, M.B., C.M., 179 Bath street. 1895
*a*M'Intyre, T. W., 21 Bothwell st. 1900
Macintyre, Wm, F.E.I.S., Dalmarnock School, Glasgow. 1888
Mackay, R. C., 82 West Regent st. 1903
550*a*M'Kechnie, D., 14 Candleriggs. 1900
M'Kellar, John C., 45 West Nile st. 1896
M'Kellar, J., 25 Kelvinside terrace. 1893
Mackendrick, Alex., 518 Sauchiehall street. 1905
*a*M'Kendrick, John G., M.D., C.M., LL.D., F.R.S., F.R.S.E., F.R.C.P.E., *Emeritus*-Professor of Physiology in the University of Glasgow, Maxieburn, Stonehaven, N.B. *Hon. Vice-President.* 1877
555 M'Kendrick, J. Souttar, M.D., F.R.S.E., 2 Buckingham terrace. 1900
Mackenzie, Robert, 176 St Vincent street. 1905
*a*M'Kenzie, W. D., 43 Howard street. 1875
Mackie, Alexander, Bank of Scotland, Glasgow. 1906
M'Kie, John, M.B., C.M., 24 Hillside terrace. 1899
560 Mackillop, Fred. G., M.A., LL.B., 208 St Vincent street. 1901
*a*Mackinlay, James Murray, The Lee, Merchiston, Edinburgh, 1886
*a*Mackinlay, J. T. C., 60 Montgomerie drive, Kelvinside. 1900
*a*Mackinlay, R. W., 52 Aytoun road, Pollokshields. 1900
Mackintosh, Donald J., M.B., C.M., Western Infirmary, 1894
565 Mackintosh, Walter, 19 Roxburgh street, Kelvinside. 1905
*a*Mackinnon, John, 170 Hope street, 1904
Mackinnon, William, C.A., 34 West George street. 1904
MacLachlan, Dugald, B.L., 30 Renfield street. 1901
Maclae, A. Crum, 192 St Vincent street. 1884
570 M'Laren, Robert, Royal Bank, Garscube cross. 1898
MacLaurin, Robert, 13 Claremont gardens, Milngavie. 1895
M'Lay, James, C.A., 94 Hope street. 1900
Maclay, William, Thornwood Hall, Langside. 1893
M'Lean, Angus, B.Sc. (Lond.), C.E., Principal, Technical College, Paisley. 1897
575 Maclean, A. B., Craigpark Works, Flemington street, Springburn. 1899
M'Lean, Charles R., L.R.C.P.E., L.R.P.S.G., 12 Annfield place, Dennistoun. 1900
Maclean, Magnus, M.A., D.Sc., F.R.S.E., Professor of Electrical Engineering, Glasgow and West of Scotland Technical College, 51 Kersland terrace, Hillhead. 1885
*a*MacLehose, James, M.A., 61 St Vincent street, 1882
MacLellan, Lewis, 5 Bowmont gard. 1899
580*a*Maclellan, Peter, Glasgow Rubber Works, Maryhill. 1900
*a*Maclellan, Wm. Walter, 3 Montague terrace, Kelvinside. 1900
*a*Macleod, A., 54 Tytherton road, Tufnell park, London, N. 1893
*a*Macleod, Frederick Larkins, 142 St. Vincent street. 1901
M'Michael, Thomas, M.A., B.Sc., 54 Windsor street. 1901
585 M'Millan, A. Lewis, M.D., C.M., 1 Rosebery terrace, Great Western road. 1897
M'Millan, Archibald, 5 Whittinghame gardens. 1899

M'Millan, Robert, Methlan park, Dumbarton. 1901
*a*Macnab, James, Lilyburn, Milton of Campsie, Stirlingshire. 1901
Macnair, John, 136 Claythorn street, and 1 Morris place, Monteith row. 1900
590 Macnair, Matthew, 1 Morris place, Monteith row. 1901
Macphail, Donald, M.D., Garturk cottage, Whifflet, Coatbridge. 1877
Macpherson, Duncan, Centre street School. 1900
Macquaker, Thomas, 89 West Regent street. 1902
M'Raith, James N., 4 Queen's square, Strathbungo. 1900
595 M'Vail, D. C., M.B., Professor of Clinical Medicine, St Mungo's College, 3 St James' terrace, Hillhead. 1873
M'Vail, John C., M.D., D.P.H. (Camb.), 20 Eton place, Hillhead. 1904
*a*Macwhannell, Ninian, 58 West Regent street. 1898
M'Whirter, W., 3 Albany street, Kelvinside. 1901
Main, Robert B., Lyndhurst, 1 Winton drive, Kelvinside. 1885
600 Malloch, A. M., Firhill, Garscube road. 1896
*a*Mann, James, Castlecraig, Dolphinton, Peeblesshire. 1900
*a*Mann, John, C.A., 142 St Vincent street, *Hon. Treasurer.* 1856
*a*Mann, John, jun., M.A., C.A., 142 St Vincent street, *Vice-President.* 1885
Mann, Ludovic MacLellan, 142 St Vincent street. 1897
605*a*Mann, Robert M., 3 Montgomerie crescent. 1900
Manwell, James, The Hut, 4 Albert drive, Pollokshields. 1876
Marks, Samuel, 145 Great Eastern rd. 1884
Marr, John, J.P., Dunjarg, Bellahouston, Govan. 1900
Marr, Hamilton Clelland, M.D., Woodilee Asylum, Lenzie. 1899
610 Marshall, James, Woodcroft, Crow road, Partick. 1900
*a*Marshall, Robt., 97 Wellington street. 1900
Martin, Jas F., 63 Brunswick st. 1895
Martin, John, writer, 58 West Regent street. 1901
Martin, Robert, 23 Wilson street, Hillhead. 1897
615 Martin, William, 63 Brunswick st. 1903
Marwick, Sir J. D., LL.D., F.R.S.E., 19 Woodside terrace. 1878
Mathie, George M., Mayfield Clincarthill. 1895
Mathieson, J. H., 6 Park circus place. 1896
*a*Mathieson, T. O., 1 Park gardens. 1896
620 Mavor, Henry A., *Vice-President,* 47 Broad street, Mile-end. 1887
Mavor, Samuel, 37 Burnbank gard. 1890
*a*Maxwell, Sir John Stirling, Bart., Pollok House, Pollokshaws. 1905
May, A. H., 15 Athole gardens. 1898
Meares, H. P., 34 Ancaster drive, Jordanhill. 1902
625 Mechan, Arthur, Scotstoun Ironworks. 1876
*a*Mechan, Henry, Scotstoun Iron Works, Scotstoun. 1879
Medley, Dudley J., M.A., Professor of History in Glasgow University, 6 University gardens. 1901
Mellanby, A. L., D.Sc., Professor of Motive Power Engineering, The Technical College, Glasgow. 1905
Menzies, William Crawford, City Improvement Trust, 22 King st. 1895
630 Millar, D. S., 141 St Vincent street. 1887
Millar, James, 152 Parliamentary road. 1870
Millar, Robert, 2 Rosslyn terrace, Kelvinside. 1903
*a*Miller, Alexander Wingate, 79 West Nile street. 1900
Miller, Alexander, junr., Dalmuir House, Dalmuir. 1899
635*a*Miller, Arch. Russell, Hillpark, Bothwell. 1884
*a*Miller, George, Surrey House, Victoria Embankment, London, W.C. 1881
Miller, Hugh, M.A., F.E.I.S., 2 Bogton Avenue, Cathcart. 1901
*a*Miller, J. C., 188 St Vincent street. 1900
*a*Miller, Thomas Hodgson, Westcroft, Cleveland Walk, Bath. 1901
640*a*Mirrlees, William J., 45 Scotland st. 1889
Mitchell, Alexander Brown, Avon Bank house, Larkhall. 1901
*a*Mitchell, Alex. Moncrieff, 8 Kew terrace, Kelvinside. 1903
Mitchell, Andrew, C.A., The Glasgow District Subway Co., St Enoch square Station. 1896
*a*Mitchell, Andrew Acworth, 7 Huntly gardens. 1903
645*a*Mitchell, George A., F.R.S.E., 5 West Regent street. 1883
Mitchell, Wm James, M.A., B.L., 48 West George street. 1897
*a*Moffatt, Alexander, 23 Abercromby place, Edinburgh. 1874
Mollison, James, 30 Balshagray aven., Partick. 1889
*a*Mond, Robert Ludwig, B.A. (Cantab.), F.R.S.E., 20 Avenue rd., Regent's park, London, N.W. 1890

650*a*Monro, T. K., M.A., M.D., F.F.P.S.G., Professor of Medicine in St Mungo's College, 12 Somerset place. 1897
*a*Monteith, Robert, Greenbank, Dowanhill gardens. 1885
Moore, Alexander, C.A., Deanville, Bridge of Allan. 1869
Moore, Alexander George, M.A., B.Sc., 13 Clairmont gardens. 1886
*a*Moore, Robert Thomas, D.Sc., 13 Claremont gardens. 1904
655 Morison, John L., M.A., The University, Glasgow. 1907
Morrice, Jas A., 1 Prince's ter., Dowanhill. 1883
*a*Morton, George, Horslethill road, Kelvinside. 1902
Morton, James S., 118 Queen st. 1903
Motion, James Russell, 266 George street. 1887
660 Motion, Thomas Mason, 54 Grant street, W. 1897
Muir, Alexander, 134 Nithsdale road, Strathbungo. 1883
*a*Muir, Allan, Ardmay, Newlands road, Langside. 1881
*a*Muir, James, D.Sc., M.A., Professor of Natural Philosophy, Technical College, Glasgow, 189 Renfrew st. 1904
Muir, Robert, M.D., F.R.C.P.E., Professor of Pathology in Glasgow University, 16 Victoria crescent, Dowanhill. 1899
665*a*Muirhead, Andrew Erskine, Cart Forge, Cathcart. 1873
Muirhead, James, 2 Bowmont gardens, Kelvinside. 1887
*a*Muirhead, Robert F., M.A., D.Sc., 64 Great George street, Hillhead. 1879
Munro, Alexander, M.B., C.M., 12 Seton Terrace, Dennistoun. 1900
*a*Munro, Donald Mackay, 88 St Vincent street. 1901
670 Munro, J. M. M., M.Inst. E.E., M.Inst.C.E., F.R.S.E., 136 Bothwell street. 1896
Murdoch, Alexander, 557 Alexandra Parade. 1905
Murdoch, George, 40 St Vincent pl. 1894
Murdoch, John, 208 West George st. 1901
Murdoch, John, Chemist, 694 Duke street. 1907
675*a*Murdoch, Robert, 91 Maxwell road. 1880
*a*Murray, A. S. 169 West George st. 1905
Murray, Charles Robert, Woodbank, Partickhill. 1902
*a*Murray, Daniel, 5 Wilton crescent. 1896
*a*Murray, David, LL.D., 169 West George street, *President*. 1876
680 Murray, John Bruce, 24 George sq. 1890
Murray, J. Campbell, 216 West George street. 1906
Murray, R. A., C.A., 175 West George street. 1905

*a*Naismith, William W., C.A., 57 Hamilton drive, Hillhead. 1907
Napier, Alex., M.D., F.F.P.S.G., Rose Bank, Queen Mary avenue, Crosshill. 1886
685 Napier, Robert T., 75 Bothwell street, Glasgow. 1899
*a*Neilson, George, LL.D., Wellfield, Partickhill road. 1897
*a*Neilson, James, 116 Bishop street, Port-Dundas. 1896
*a*Neilson, John, Mollance, Castle-Douglas. 1900
*a*Neilson, Walter, Ewenfield, Ayr. 1900
690 Nelson, Alex., 63 N. Frederick st. 1880
*a*Nelson, John E., 26 Queen street. 1900
Nelson, Thos C., Craiglea, Dennistoun. 1900
Ness, James, M.A., LL.B., 216 West George street. 1904
Ness, Professor R. Barclay, M.A., M.B., 19 Woodside place. 1902
695*a*Newlands, Joseph F., 105 West George street. 1883
Nicol, James Monro, 93 Cheapside street. 1901
Nicol, William Smith, F.F.A., 30 Renfield street. 1905
Nicolson, W. B., 54 Hill street, Garnethill. 1906
*a*Nicoll, Professor James H., M.B., 4 Woodside place. 1897
700*a*Nisbet, John, 112 Bath street. 1905
Nish, Robert, 9 Claremont terrace. 1897

Orr, George Smith, 139 St Vincent street. 1901
Orr, John, 101 Wellington street. 1901
*a*Osborne, Hugh, 4 Kew terrace, Glasgow. 1899
705*a*Oswald, Dr Landel Rose, Glasgow Royal Asylum. 1902
Overtoun, The Right Hon. Lord, D.L., Overtoun, Dumbarton. 1906

Park, James, 95 St James road. 1877
*a*Park, Colonel J. Smith, V.D., 20 Park terrace. 1900
Park, Robert, M.D., 40 Grant st. 1894
710 Parker, James H., B.L., C.A., 89 West Regent street. 1900
*a*Parker John Dunlop, C.E., 146 West Regent street. 1889
*a*Parnie, William, 27 Union street. 1897
Parry, Robert Henry, F.R.C.S.E., 25 Blythswood square. 1900

*a*Paterson, Robert, C.A., J.P., 105 West George street. 1881
715 Paterson, Thomas Y., 4 Lorraine gardens, Dowanhill, Glasgow. 1907
Paterson, Wm., M.B., C.M. (Edin.) 43 Millbrae Road, Langside. 1902
Paton, James, F.L.S., Glasgow Art Gallery and Museum, Kelvingrove. 1876
Patrick, Joseph, M.A., C.A., 203 West George street. 1893
Patrick, Joseph, Royal Exchange buildings. 1900
720 Patterson, T. L., F.C.S., Maybank, Finnart street, Greenock. 1873
Petrie, John W., 4 Garrioch drive, Kelvinside, N. 1900
Pettigrew, Andrew H., 3 Claremont terrace. 1902
*a*Picken, David Kennedy, B.A., Ashburne, Partickhill. 1903
Pinkerton, Surgeon-Major-General, J., M.D., K.H.P., Queen's Park House, Langside. 1900
725*a*Pirrie, Robert, 9 Buckingham ter. 1875
Playfair, David James, 7 Victoria crescent, Dowanhill. 1901
Pollock, A. Barr, M.B., C.M., 3 Belgrave terrace, Hillhead. 1897
*a*Pollock, R., M.B., C.M., F.F.P.S.G., Laurieston house, Pollokshields. 1883
Prentice, Thomas, 15 Eglinton drive, Kelvinside. 1905
730 Provand, A. D., 2 Whitehall court, London, S.W. 1888
Purdie, Wm G., 130 Cambridge drive. 1906

Raalte, Jacques Van, c/o M. Van Raalte, Esq., 22 Austen Friars, London, E.C. 1884
*a*Ralston, William Henry, 4 North Court, Royal Exchange. 1900
Ramsey, Robert, 14 Park terrace. 1889
735*a*Ramsey, Robert, junr., 14 Park ter. 1898
Rankin, The Rev. W. M., B.D., clergyman, 8 Craigpark, Dennistoun. 1900
Rankine, Adam, Rolandseck, Bridge of Weir. 1901
Rankine, David, C.E., 238 West George street. 1875
*a*Reid, Andrew Thomson, 10 Woodside terrace. 1900
740 Reid, David, 18 Cambridge street. 1887
*a*Reid, Hugh, Belmont, Springburn. 1880
*a*Reid, James A., Dean of Faculty of Procurators, 172 St Vincent street. 1904
Reid, James, 15 Montgomerie crescent. 1886
*a*Reid, Joseph, 32 Newark drive, Pollokshields. 1901
745*a*Reid, Nicholas M'Whirter, 7 Oakley terrace, Dennistoun. 1901
Reid, Thos, M.D., LL.D., 11 Elmbank street. 1869
Reid, William, M.A., 61 Grant street. 1881
*a*Reid, Walter M. N., 10 Woodside terrace. 1904
*a*Reid, William L., M.D., 7 Royal crescent, West. 1882
750 Renton, James Crawford, M.D., L.R.C.P. & S.Ed., 1 Woodside terrace. 1875
*a*Rennie, John, Wellcroft, Helensburgh. 1901
Rennie, Thomas, Glasgow Art Gallery and Museum, Kelvingrove. 1905
*a*Renwick, Wm, Langgarth, Stirling. 1901
Robb, George, carting superintendent, Caledonian Railway. 1901
755 Robb, Thomas D., M.A., Auchinsale, Potterhill, Paisley. 1906
Robb, William, F.R.C.V.S., 6 Canning place, Stirling road. 1900
*a*Roberton, William, 223 Sauchiehall street, Glasgow. 1899
*a*Robertson, Henry Tod, Meadowbank, Airdrie. 1901
Robertson, J. M'Gregor, M.A., M.B., C.M., 26 Buckingham ter., Hillhead. 1881
760*a*Robertson, Robert, B.Sc., M.Inst. C.E., M.I.E.E., etc., 154 West George street. 1900
Robertson, Robert H., Clyde bank, Rutherglen. 1888
Robertson, Wm, 45 West Nile st. 1900
Rodger, Anderson, Glenpark, Port-Glasgow. 1899
Roemmele, C. H., 34 Kelvinside gardens. 1900
765*a*Rogers, John C., 204 Bath street. 1888
Rose, Alexander, Richmond house, Dowanhill. 1879
Rose, James A., 11 Kirklee road, Kelvinside. 1907
*a*Ross, John, Lochbrae House, Bearsden. 1885
Ross, John, Munn, C.A., 117 Wellington street. 1894
770 Ross, Russell James, manager, Parkhead Steel Works, 7 Ashfield gardens, Jordanhill. 1901
Rottenburg, Fritz, 55 West Regent street. 1905
*a*Rottenburg, Paul, LL.D,. 55 West Regent street. 1872
Rowan, John, M.B., F.F.P.S.G., 10 Woodside crescent. 1900
Rowan, W. G., 234 West George street. 1881

775*a*Rowley, Thos, Campbell street, Govan. 1901
Russell, James, c/o Cluness, 25 Woodside quadrant. 1904
Russell, Robert, M.E., Coltness Iron Co., Ltd., Newmains, Lanarkshire. 1901
Russell, William W., M.A., 235 West Princes street. 1906

Salmon, W. Forrest, F.R.I.B.A., 53 Bothwell street. 1870
780*a*Samuel, John Smith, F.R.S.E., J.P., secretary to the Lord Provost of Glasgow, City Chambers. 1901
Sandeman, B., Ferndean, Lenzie. 1900
Sandilands, Robert Douglas, 4 Jane street, Blythswood square. 1902
*a*Sawers, George B., Hydepark Locomotive Works, Glasgow. 1907
Sawers, William D., Assoc.I.C., Athole Garden place. 1894
785 Sayers, William Brooks, M.I.E.E., 189 St Vincent street. 1890
Scoble, Walter A., B.Sc., Glenturret, Paisley road, Renfrew. 1906
Scott, Alexander, M.D., 12 Newton place. 1900
Scott, Alex., 34 Lawrence street, Dowanhill. 1871
*a*Scott, D. M'Laren, The Grange, Bearsden. 1881
790 Scott, John, 249 West George street. 1892
*a*Service, Edward, 92 St Vincent street. 1901
Service, R. Gibson, 14 Royal Exchange buildings. 1900
*a*Service, William, 1 Queen's gate, Dowanhill. 1900
Sexton, A. Humboldt, F.C.S., F.I.C., F.R.S.E., Professor of Metallurgy, Glasgow and West of Scotland Technical College, 204 George street. 1892
795 Shand, F. J., 4 Bowmont gardens, Kelvinside. 1903
*a*Shanks, J. B., 46 Gordon street. 1900
*a*Shaw, A. M'Innes, Dunard, Sydenham, Dowanhill. 1900
Shaw, William, 30 Lynedoch street. 1900
*a*Shearer, William, 108 St Vincent street. 1901
800*a*Sherriff, George, Carronvale, Larbert, Stirlingshire. 1900
Shields, Daniel, 104 West George street. 1900
Simons, Michael, 2 Kensington gate. 1880
*a*Simpson, J. C., M.D., 9 Marlborough terrace, Kelvinside. 1896
Sloan, Samuel, M.D., 5 Somerset place. 1877
805 Sloan, William, Dunara, Helensburgh. 1905
Smart, William, M.A., LL.D., Professor of Political Economy, University of Glasgow, Nunholm, Dowanhill. 1886
Smellie, James, I.M., 112 Bath street. 1901
*a*Smith, Andrew, Miltonlea, Kilmacolm. 1901
Smith, Colonel J. N., V.D., Dykebar house, Hawkhead, Paisley. 1900
810 Smith, D. Johnstone, C.A., 142 St Vincent street. 1888
*a*Smith, David Baird, LL.B., 205 St Vincent street. 1903
*a*Smith, Fred. J., 40 St Vincent place. 1901
Smith, George, 1 Annfield terrace, East Partick. 1901
Smith, G. Comrie, 4 Camphill avenue, Langside. 1903
815 Smith, Hugh C., 55 Bath street. 1861
*a*Smith, J. Guthrie, 205 St Vincent street. 1875
*a*Smith, James Murray, 11 Bute gard. 1901
*a*Smith, Lewis O., 2 Windsor terrace, West. 1907
Smith, Patrick A., M.D., F.F.P.S.G., J.P., Dundrennan, 50 Queen Mary avenue, Crosshill. 1900
820*a*Smith, Robert B., 28 Glisson road, Cambridge. 1884
*a*Smith, W. B., 34 Newark drive, Pollokshields. 1895
*a*Smith, W. Robertson, 8 Windsor terrace, W. 1902
Snodgrass, J. F., Ashbourne, Winton drive, Kelvinside. 1900
Snodgrass, William, M.A., M.B., C.M., F.F.P.S.G., 11 Victoria cres., Dowanhill. 1890
825 Soddy, Frederick, M.A., Chemistry Department, Glasgow University. 1904
*a*Somerville, Alex., B.Sc., F.L.S., 4 Bute mansions, Hillhead. 1888
Speirs, William, Junr., Invershiel, Lenzie. 1905
*a*Spencer, Charles L., Edgehill, Kelvinside. 1891
*a*Spencer, J. J., Edgehill, Kelvinside. 1895
830 Spens, John A., 169 West George street. 1879
*a*Steel, James, M.A., 502 St Vincent street. 1901
*a*Steel, William Strang, Philiphaugh, Selkirk. 1889
*a*Stephen, John, Domira, Partick. 1880
Sterling, John Lockhart, 62 Bothwell circus. 1901
835 Steven, Henry, 35 College street. 1900
Steven John, Eastvale place, Kelvinhaugh. 1875

*a*Stevenson, D. M., 12 Waterloo street. 1889
Stevenson, John G., 147 St Vincent street. 1903
Stevenson, J. V., Dunacre, Beech avenue, Bellahouston. 1902
840 Stevenson, Samuel, 4 Royal terrace, Crosshill. 1902
Stevenson, William, 13 Carlton place. 1888
Stewart, Allan Alfred, 180 Hope street. 1901
Stewart, David, Noorlinn, Dunblane, 1859
Stewart, John, 220 Parliamentary road. 1899
845 Stewart, Robert, Ellerslie, Partickhill. 1899
*a*Stewart, Robertson Buchanan, 146 Argyle street. 1901
Stobo, John, M.A., Teacher, 142 St. George's road. 1906
*a*Stobo, Thomas, Somerset house, Garelochhead. 1884
Stockdale, H. F., Clairinch, Upper Helensburgh. 1899
850 Stockman, Ralph, M.D., F.R.S.E., Professor of Materia Medica, The University of Glasgow. 1897
Stoddart, James Edward, Howden, Mid-Calder, N.B. 1872
Strachan, George, Fairfield Works, Govan. 1900
*a*Strain, James M., 15 Kingsborough gardens, W. 1900
*a*Strain, John, C.E., Cassilis House, Maybole, Ayrshire. 1876
855 Strathie, David, C.A., 162 St Vincent street. 1895
*a*Sutherland, David, Balmaccara Hotel, Lochalsh. 1880
*a*Sutherland, John, Columba Hotel, Oban. 1880
Sutherland, J. R., C.E., 45 John street. 1884
Swan, Charles C., 30 Renfield st. 1891

860 Tait, William, 2 Knowe terrace, Pollokshields. 1902
Tannock, William, Woodend, Tarbolton. 1906
Tatlock, John, F.I.C., 13 Parkgrove terrace, West, Sandyford. 1875
Tatlock, Robert R., F.R.S.E., F.I.C., F.C.S., 156 Bath street. 1868
Taylor, Benjamin, F.R.G.S., 10 Derby crescent, Kelvinside. 1872
865 Taylor, James, 143 West Regent street. 1906
*a*Teacher, John H., M.B., C.M., 32 Kingsborough gardens, Dowanhill. 1898
Templeton, James, 2 Claremont terrace. 1900
Templeton, John Stewart, William street, Calton. 1900
Tennant, Alexander, Bothwell Bank, Bothwell. 1905
870*a*Tennent, Gavin P., M.D., 159 Bath street. 1875
Thomas, Moses, M.D., 1 Spring gardens, Kelvinside. 1890
*a*Thomson, Edward J., Western Club. 1904
Thomson, Gilbert, M.A., C.E., 164 Bath street. 1885
Todd, John Aiton, B.L., 190 West George street. 1897
875 Townsend, C. W., Crawford street, Port-Dundas. 1890
Trotter, John, 40 Gordon street. 1899
*a*Tullis, James Thomson, Aytoun, Sydenham road, Dowanhill, 1883
*a*Tullis, John, John street, Bridgeton. 1900
Turpie, John, 420 Sauchiehall street. 1896

880 Ure, William P., Balvaird, Helensburgh 1893

Vaughan, J., 7 Campside crescent, Langside. 1902

*a*Waddell, Robert Davidson, Rednock, Kelvinside, W. 1901
Walker, Adam, 2 Newton place. 1880
*a*Walker, Alexander, City Chambers. 1903
885*a*Walker, Archibald, M.A. (Oxon.), F.I.C., F.C.S., 7 Crown terrace, Dowanhill. 1858
Walker, J. W. O., 12 The Polygon, Eccles., Manchester. 1896
*a*Walker, William H., Cardarroch House, Airdrie. 1900
Wallace, James Wilson, M.D., C.M., Cairnsmore, 67 St Andrew's drive, Pollokshields. 1900
Wallace, William, M.A., LL.D., barrister-at-law, 42 Athole gardens, Dowanhill. 1900
890*a*Walker, Hugh, M.A., M.B., C.M., 52 Kilmarnock road, Shawlands. 1903
Walker, James A., 206 Bath street. 1898
*a*Wallace, Wm., M.A., M.B., C.M., 25 Newton place. 1888
*a*Wardlaw, Alex., The Clydesdale Bank, Ltd. 1900
Wardlaw, Robert S., 25 High street, Tillicoultry. 1906
895 Warren, John A., C.E., 94 Hope street. 1887
Watson, Archibald, 9 Montgomerie drive, Kelvinside. 1881
Watson, Harold, 9 Holland place. 1901
Watson, James, 6 Kirklee road, Kelvinside, W. 1873

Watson, John, National Bank, Crosshill. 1900
900 Watson, Joseph, Chappell, Barrhead. 1882
*a*Watson, J. Robertson, M.A., Professor of Chemistry, Anderson's College Medical School, Dumbarton road. 1891
*a*Watson, Thomas Lennox, I.A., F.R.I.B.A., 166 Bath street. 1876
*a*Weir, James, 72 St Andrew's drive, Pollokshields. 1902
*a*Weir, William, Shewalton, Dreghorn. 1901
905 Welsh, John M., Ph.D., F.E.I.S., F.R.G.S., 17 Brownlie street, Mount Florida. 1897
White, John, Scotstoun Mills, Partick. 1897
*a*Whitson, Jas, M.D., F.F.P.S.G., Blairgowrie. 1882
Wield, John, 9 Barns street, Ayr. 1895
Wilkie, Daniel, 53 Bothwell street. 1906
910 Williams, Alexander Malcolm, M.A., Church of Scotland Training College. 1903
Williamson, John, 65 West Regent street. 1881
*a*Watson, William W., 5 Westbourne terrace. 1899
Watt, Alexander, 183 St Vincent street. 1900
Webster, H.Carvick, 48 Montgomerie drive. 1900
915 Wilson, Alex., Hydepark Foundry, 54 Finnieston street. 1874
*a*Wilson, David, M.A., D.Sc., F.C.S., Carbeth, Killearn. 1898
Wilson, Thomas F., 163 Hope st. 1901
Wilson, Thomas, 119 Finsbury Pavement, London, c/o Thos. Brown & Sons, Ltd. 1902
Wilson, Walter Stuart, 4 St John's terrace. 1901
920 Wilson, Wm, F.E.I.S., Schoolhouse, Pavenham, Bedford. 1889
Wingate, Arthur, Broomcraig, Largs. 1882
Wingate, Walter E., 1 King's Gate, Glasgow, W. 1880
Wood, Adam, Portland villa, Troon. 1901
Wood, James, Dunard Street Public School, 23 Cranworth st., Hillhead. 1900
925 Wood, James, M.A., Glasgow Academy. 1885
*a*Wood, William James, 266 George street. 1893
Woodrow, Alexander, 75 Glassford street. 1900
Woodrow, Alexander Norie, 75 Glassford street. 1900
*a*Workman, Chas, M.D., F.F.P., & S.G., Professor of Pathology, St Mungo's College, 5 Woodside ter. 1898
930 Wright, Robert Patrick, Professor of Agriculture, West of Scotland Agricultural College, 6 Blythswood square. 1895
Wylie, William A., 13 Woodside terrace. 1901
Wyllie, Archibald D., 1 Minard terrace, Partickhill. 1905
Wyper, James, Nithsdale Lodge, Pollokshields. 1900

Yellowlees, D., M.D., LL.D., 6 Albert gate. 1881
935 Young, Frank W., H.M. Inspector of Schools, 32 Buckingham ter. 1902
Young, Fred H., 2 Woodside ter. 1907
*a*Young, James, jun., Caerleon, Bearsden. 1900
*a*Young, John E., 24 Belhaven ter, Kelvinside. 1900
Young, John, 8 Athole gardens, Hillhead. 1900
940 Young, John, 2 Montague terrace, Kelvinside. 1885
*a*Young, John, M.A,. B.Sc., 28 Bank street, Hillhead. 1887
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